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TWENTY-SECOND EDITION.

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PREFACE

To the Twenty-Second Edition.

This Edition has been thoroughly revised and brought right up to date.

Numerous additions have been inserted including Boat Sailing with diagrams, Shipbuilding, Stability, Meteorology, Deviation of the Compass and Proofs of Trigonometrical Equations.

The papers on Meteorology have all of them been given for First Mates and Masters, and the answers will be found to be most complete.

The Shipbuilding papers between pages 413 and 424 have been given to Extra Masters and are now given to Masters to answer in writing. This is the first time these Board of Trade questions on Shipbuilding have appeared in print.

The Extra Master's questions on Deviation of the Compass have been added to the previous 45, as candidates for Master must now be able to answer them.

The Trigonometrical Equations should be learned and understood by all grades. Those inserted are only a few, but they will prove a splendid foundation to the others, which will eventually appear in the new guide books.

August, 1918.

METEOROLOGY.

The pages referring to the "Seaman's Handbook" in the examination papers on Meteorology are for the *Second Edition.*

The Third Edition is now published and the equivalent pages are as follows:—

Second Edition.	Third Edition.
19 to 53	20 to 54
54 „ 58	56 „ 60
59 „ 61	62 „ 64
62 „ 120	66 „ 124
121 „ 122	127 „ 128
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147 „ 170	155 „ 178

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OFFICERS IN STEAM SHIPS ONLY.

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REED'S SEAMANSHIP.

SYLLABUS OF STEAMSHIP EXAMINATION
FOR OFFICERS IN *STEAMSHIPS* ONLY.*

SECOND MATE.

The Candidate must understand and be able to give satisfactory answers on the following subjects :—

(*a.*) The standing and running rigging of steamships.

(*b.*) Bending, unbending, setting, reefing, taking in and furling sail.

(*c.*) Sending masts and yards up and down, &c.

(*d.*) Seeing everything in readiness and clear for getting under weigh, and the precautions to be then observed with regard to engines, propeller, &c.

(*e.*) Care and usage of patent logs and leads.

(*f.*) Management of a ship's boat in heavy weather.

(*g.*) Dunnaging and stowing cargo, &c.

(*h.*) The Rule of the Road as regards both steamers and sailing vessels, their regulation lights and fog and sound signals.

(*i.*) Signals of distress, and signals to be made by ships wanting a pilot, and the liabilities and penalties incurred by the misuse of these signals.

(*j.*) The marking and use of the ordinary lead and log lines.

(*k.*) The construction, use, and action of the sluices, and of the water-ballast tanks.

---

*Candidates for ordinary certificates will in addition have to answer questions relating to sailing ships.

(*l.*) Engine-room and other telegraphs used on board ship, and deck appliances generally.

(*m.*) Use and management of the rocket apparatus in the event of a vessel being stranded.

(*n.*) Any other questions of a like nature appertaining to the duties of a Second Mate of a steamship which the Examiner may think necessary to ask.

ADDITIONAL FOR ONLY AND FIRST MATE.

In addition to the qualifications required for a Second Mate's Certificate, an Only or First Mate will be required to show a knowledge of the following subjects :—

(*a.*) Shifting large spars; rigging sheers; and taking lower masts in and out.

(*b.*) How to moor and unmoor ship; keep a clear anchor; and carry out an anchor.

(*c.*) Management of a steamship in stormy weather.

(*d.*) How to rig purchases for getting heavy weights, anchors, machinery, &c., in and out.

(*e.*) How to dispose various kinds of cargo and weights, in a stiff, and in a tender vessel.

(*f.*) Ventilation of holds, and stowage of explosives.

(*g.*) Stowage of grain cargoes.

(*h.*) The effects of the screw race upon the rudder; and the effect produced on the direction of the head of the ship by going [ahead] [astern] with a [right] [left] handed screw when the rudder is [ported] [starboarded]; also, the effect of twin screws under the same conditions, and when going ahead with one and reversing the other, &c., &c.

(*i.*) How to rig a sea anchor, and what means to employ to keep a steamer, with her machinery disabled, out of the trough of the sea, and to lessen her lee drift.

(*j.*) How to turn a steamship short round.

(*k.*) How to get a cast of the deep sea lead in heavy weather.

(*l.*) Any other questions of a like nature appertaining to the duties of a First Mate of a steamship which the Examiner may think necessary to put to him.

ADDITIONAL FOR MASTER.

In addition to the qualifications required for the grades of Second and First Mate, a Master will be required to show a knowledge of the following subjects :—

(*a.*) Construction of rafts and jury rudders suitable for screw steamships.

(*b.*) The preservation of the ship's crew in the event of wreck.

(*c.*) Management of steamships in heavy weather.

(*d.*) Rescuing the crew of a disabled ship.

(*e.*) Steps to be taken when a vessel is on her beam ends, or disabled and on a lee shore.

(*f.*) How to use steam appliances in the event of fire.

(*g.*) Economy in coal consumption.

(*h.*) The best arrangement for towing vessels under different circumstances.

(*i.*) Placing ship in dry dock; directing repairs; and the mode of procedure when putting into port in distress with damage to cargo and ship.

(*j.*) Any other questions of a like nature, appertaining to the management of a steamship which the Examiner may think it necessary to put to him.

ADDITIONAL FOR EXTRA MASTER.

In addition to the qualifications required of a Master of a foreign-going steamship, the Extra Master will be expected to give satisfactory answers to any questions appertaining to the management of a steamship that the Examiner may put to him.

SEAMANSHIP REQUIRED FOR SECOND MATE.

Miscellaneous Questions.

Q. You are appointed to a ship ready to take in cargo, what is the first thing you would do on going on board ?

Ans. Report myself and ask for orders.

Q. And then, if no special orders were given ?

Ans. Go into the hold, see that the limbers were clear, the holds well swept, dunnage properly laid, strums clear, and the pumps in working order.

Q. And then ?

Ans. Take an account of everything that would be under my charge. Make myself acquainted with the working of the windlass, steering gear, winches, &c.

Q. If your ship were ready to proceed to sea, what would you see to ?

Ans. That the hatches were battened, and everything securely lashed; that the wheel-chains were clear, and their ends properly secured; see that no nails or other iron is near the binnacles, and see that the lead and log lines are properly marked, and put them away myself, so that I should know where to lay my hand upon them at a moment's notice. Have the towline and other warps and lines ready; see that all necessary gear is bent and rove.

Q. You are in charge of the deck, coming on dark, ship labouring a good deal, what would you do before darkness set in ?

Ans. See all running gear coiled up and hung on the pins, halliards overhauled ready to let go, everything secured about the decks, battens and tarpaulins secure on the hatches, and that there is no chafe on the mast coats.

Q. Discharging cargo. Supposing you found only the hoops and staves of a cask in the hold; what would you do with them ?

Ans. Be sure and let them stay where they are until the master has seen them.

Q. Relieving watch at night, what would you do ?

Ans. See that all the lights are burning bright, the man on look-out is keeping a proper look-out, the man at the wheel is steering the right course, keep a good look-out myself, pay particular attention to any orders that may be left.

Q. What guide have you coming up the English Channel in a fog?

Ans. Lead and compass.

Q. Coming along the land, what is the first thing you would do, seeing a fog coming on?

Ans. Take a bearing on any point or lightship in sight, also a cast of the lead, call the master, ease the ship down and keep a good look-out. In a steamship keep the whistle going, and in a sailing ship keep the fog-horn going.

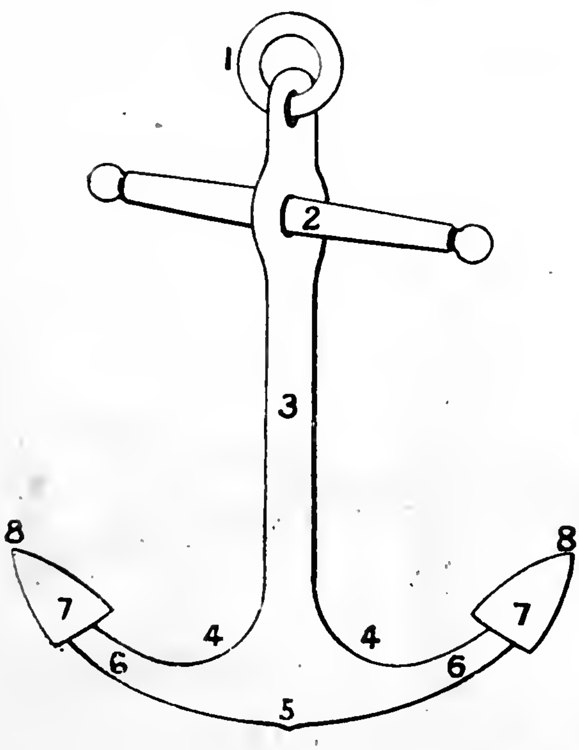
Q. What would you do after a gale?

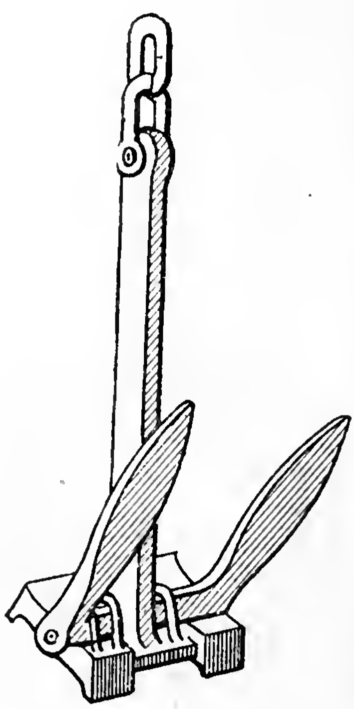
Ans. Examine everything aloft and on deck and if any damage, repair at once.

Q. Name the different parts of an anchor?

Ans. 1 Ring, 2 stock, 3 shank, 4 trend, 5 crown, 6 arm, 7 fluke and palm (flat part), 8 pea.

Fig. 1





STOCKLESS ANCHOR.

Q. You had to call the master, would you call him yourself ?

Ans. No. I should send someone to call him.

Q. Where would you make a buoy-rope fast ?

Ans. Round the crown of the anchor.

Q. Why is a buoy-rope used ?

Ans. To show the position of the anchor, (See Tending ship in a Tideway.)

Q. Lying with two anchors out, which one would you pick up first ?

Ans. Lee one ; that is the one I am not riding by.

Q. How would you carry out a kedge ?

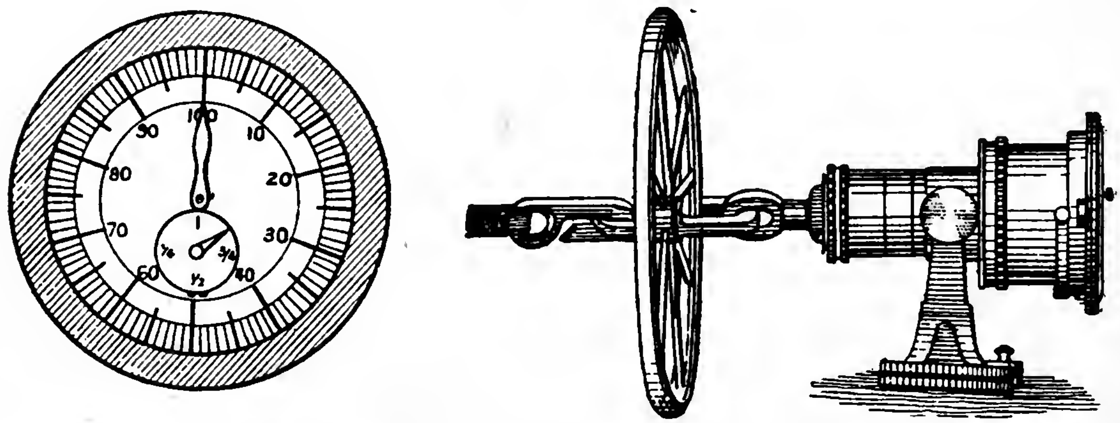
Ans. Place a plank across the quarters of the boat, and lay the flukes of the kedge on this plank, so that the stock is over the stern of the boat a little to one side of the notch. When nearly out to the place, cast the buoy astream ; when quite out, pay out sufficient warp to let the kedge reach the bottom, take hold of the plank, and so cant the kedge overboard. If the kedge is too heavy, hang it to the ring over the stern, and if too heavy to hang, get a line on to one of the flukes and haul the crown and flukes under the bottom of the boat.

A kedge could also be carried out similar to the method of carrying out a bower anchor, which is shown in another part of this book, by hanging the kedge with a rope under the middle of the boat. The spar shewn in the illustration can be dispensed with.

Q. How would you set a patent log ?

Ans. All the pointers at zero ; and always turn them forward, never backward.

Fig. 2.



DIAL AND TAFFRAIL PATENT LOG.

Q. Man overboard, what would you do ?

Ans. Bring the ship to the wind, and throw a lifebuoy, or anything that will float him, overboard ; send a hand aloft to watch him, and lower a boat ?

Q. Man overboard in a steamship (starboard side) ?

Ans. Hard-a-port to give him a chance of clearing the propeller and stop the engines, throw lifebuoy overboard, hand aloft to watch him. Keep the helm over and let the ship come round towards him and lower the boat.

Q. How many seconds in an hour ? 3600.

Q. How many feet in a nautical mile ? 6080.

Q. How many feet in a statute mile ? 5280.

Q. How many fathoms in a cable ? 100.

Q. How many cables in a mile ? 10.

Q. How many fathoms in a ship's cable ? 120 and upwards.

Q. How many square inches in a square foot ? 144.

Q. How many cubic inches in a cubic foot ? 1728.

Q. How many pounds in a hundredweight ? 112.

Q. How many hundredweights in a ton ? 20.

Q. How many pounds in a ton ? 2240.

Q. How many gallons in a barrel ? 36.

Q. How many gallons in a hogshead ?
54. (Barrel & a half.)

Q. How many gallons in a puncheon ?
72. (Two barrels.)

Q. How many gallons in a pipe or butt ?
108. (Three barrels.)
(The above gallons relate to ale or beer.)

Q. How many gallons in a bushel ? 8.

Q. How many bushels in a quarter ? 8.

Q. How many pounds are there in :—tierce of beef, barrel of pork, barrel of flour, barrel of split peas, bag of rice, and cases of beef and mutton ?

Ans. Tierce of beef 304 lbs. Barrel of split peas 224 lbs
Barrel of pork 200 „ Bag of Rice ...224 „
Barrel of flour 196 „ Cases of beef & mutton 72 „

Q. How many pounds are there in a bushel of :— wheat, barley, oats, rye, maize, and buckwheat ?

Ans.	Wheat ...	62 to 63 lbs.	Rye ...	60 lbs
	Barley ...	50 to 56 „	Maize ...	60 „
	Oats ...	38 to 42 „	Buckwheat	52 „

Q. What is the advantage in an additional mast-head light that steamships underway may carry ?

Ans. The direction of the ship's head may be ascertained without seeing the side-lights.

Q. What would you be careful about when taking a sailing ship out from between a tier of ships ?

Ans. See the yards and braces clear, so as not to foul the gear of the ships on either side.

Q. How would you run a rope away to windward ?

Ans. Coil the rope in the boat, row to windward, make the rope fast and pay out as the wind blows the boat back to the ship.

Q. There is an overhaul knot in the rope (previous question), how would you get it out ?

Ans. Overhaul the knot and reeve the boat through.

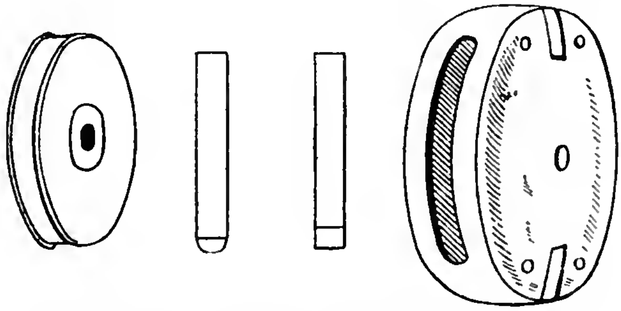
Q. There is not sufficient rope to reach the ship ?

Ans. Buoy the end of the rope with an oar, and go back to the ship for another rope to bend to it.

Name the different parts of a block ?

Ans. Shell, pin, sheave, bush, score, strop, and swallow.

Fig. 3.



SHEAVE, PINS, AND SHELL.

Q. Name the different parts of a cask ?

Ans. Staves, head pieces, (1.) chimes, chime hoops, (2.) quarter hoops, (3.) bilge hoops, (4.) bung and bung hole, (5.) No. 6 can hooks. (Fig. 4.)

Q. How would you reeve a watch tackle ?

Fig. 4.

PARTS OF A CASK.

Ans. Reeve through the double block, then through the single, through the double again and make fast to the single.

Q. What is the length of a transport line?

Ans. 100 to 112 fathoms.

Q. How would you make a square sail up to stow away in the locker?

Ans. Stretch the sail out, rope to the deck, make it up on the foot or head, and tie the stops.

Q. How would you make a fore and aft sail up to stow away in the locker?

Ans. Stretch the sail out, rope to the deck, and make it up on the after leech.

Q. Where ought you to be when loading grain in bulk?

Ans. In the hold seeing that the grain is properly trimmed, and no spaces left under the deck.

Q. How would you beach a boat in a surf?

Ans. Keep her head on, row and meet every sea, back in when they pass; just as the boat is touching the beach throw her broadside on.

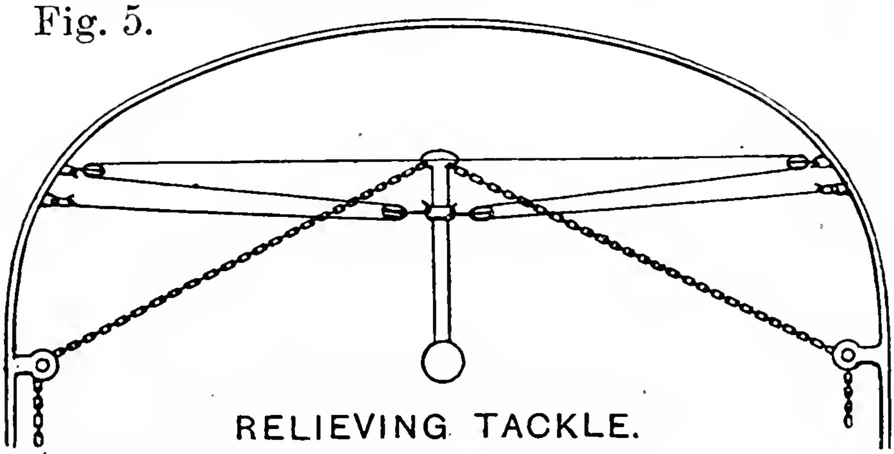
Q. What do you mean by boxing the compass?

Ans. To name the points of the compass in their proper order.

Q. How do you reeve relieving tackles (small vessels)?

Ans. Four single blocks; one at each side of the ship

Fig. 5.



RELIEVING TACKLE.

and one each side of the tiller or quadrant. Make one end of the fall fast at one side, (say the port side) and reeve the other end through the block on the tiller, then through the block on the side (port side), then right across the deck and through the block on the other side (starboard side), through the remaining block on the tiller and haul well tight, making fast to the starboard side; or both sides could be rove together making one end fast and tightening on the other.

In a larger ship two double blocks, and two single blocks are generally used.

The purchase is increased as the ship increases in size

Q. How would you reeve from a long coil ?
Ans. The reverse way to previous question.

Q. How would you take in cable chain from a lighter ?
Ans. Place the lighter under the bow and heave with the windlass the chain through the hawse pipe, making sure that the square ends of the shackles come in first.

Q. Why the square ends first ?
Ans. So that, when the anchor is let go, the round end of the shackles are not likely to catch and be stopped by any obstructions round the windlass or hawse pipe.

Q. Which end will you pass a drift net fisherman ?
Ans. The opposite end to which she is hanging to her nets. During the night the end to where the high light is seen.

Q. Approaching the land in fog, when would you take a cast of the lead ?
Ans. Directly the fog comes on. I should also ease the ship down, call the master, and keep the whistle or fog horn going ; a good look-out will have to be kept.

Q. Which side do you find the bolt rope on square and fore and aft sails ?
Ans. Rope aft for square sails, and on the port side for fore and aft.

Q. How are bolt ropes fastened to sails ?
Ans. Hemp ropes sewn to the canvas through and with the lay of the rope, and wire ropes marled.

Q. How many anchors are steam ships of 1000 tons, 2000 tons and 3000 tons required to carry ?
Ans. Three bowers, one stream and one kedge.

Q. What are the approximate weights of these anchors?

Ans. Gross Tonnage.		Bower. Cwts.		Steam. Cwts.		Kedge. Cwts.
1000	...	22	...	7	...	4
2000	...	31	...	$10\frac{1}{2}$	...	$5\frac{1}{2}$
3000	...	39	...	13	...	6
4000	...	42	...	14	...	6
5000	...	45	...	15	...	$6\frac{1}{2}$
6000	...	51	...	$17\frac{1}{2}$	...	$7\frac{1}{2}$

These weights do not include the stock.

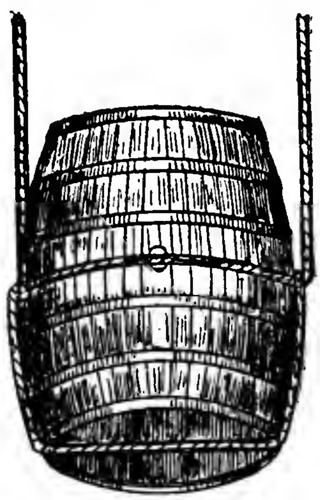
Sailing vessels require heavier anchors than steam vessels.

Q. How would you sling a cask bung up, also head up?

Fig. 6.

BUNG UP.

Fig. 7.



HEAD UP.

Ans. Bung up—Place the cask on its bilge, pass a strop underneath, bring both bights of the strop on top and pass one through the other.

Head up—Pass a rope's end under the bottom of the cask and tie an overhand knot on the top, open out the knot and slip the bights well down the cask, haul tight and tie with a reef knot on top.

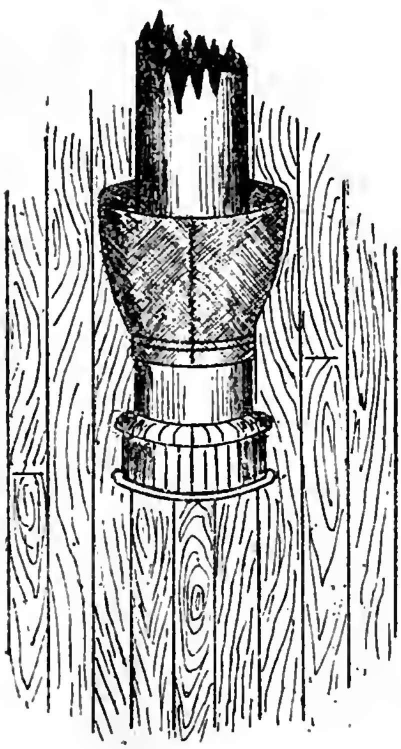
Q. How would you get a rope round the propeller clear?

Ans. Stop the engines, and if there are only a few turns, the engines could be reversed slowly, and the rope cleared. It might be necessary to employ a diver, lighten the ship aft, or go into dry dock.

What is a chesstree ?

Ans. A cleat or something equivalent to which the main tack is hauled down.

Fig. 8.



MAST COATING.

Q. How would you make a mast-coat ; and why are they necessary ?

Ans. Mast-coats are conical canvas covers fitted round the mast over the wedging at the upper deck to prevent water getting into the hold.

Not less than three pieces of canvas are cut and sewn together, so that the upper part will equal the circumference of the mast and the lower part equal to the circumference of the mast ring. The mast-coat is placed round the mast with the inside outwards and the base uppermost (Fig. 8), the head is lashed tightly round the mast and the two edges sewn together, it is then turned down and the base secured round the mast ring with an iron band. Double mast-coats are much more efficient.

Q. How would you wind a chronometer ?

Ans. Gently, with the left hand turn the instrument over in the gimbals (face downwards), uncover the keyhole and with the right hand insert the key turning slowly and steadily to the left until the last turn, remove the key and ease the chronometer gently back to its natural horizontal position.

Q. How do you know if a chronometer has been wound up ?

Ans. There is a dial with a pointer which shows when the chronometer is wound close up, how long it has been wound up and how much further it will go before running down.

Q. How would you carry a chronometer ?

Ans. Clamp the gimbals to prevent the chronometer from swinging, secure the strap round outer case, and carry steadily without any swing or jerking.

Q. What side of a leading block should be uppermost ?

Ans. The side with the head of the pin, there could then be no possible chance of the pin dropping out.

Q. What would you do if the rigging worked slack in a heavy sea ?

Ans. Lash a spar on the outside of the rigging at each side of the ship, then pass turns with a rope from spar to spar heaving the turns just tight enough to prevent the rigging working.

Q. How can you tell which way a Lightvessel is riding at night ?

Ans. A Lightvessel in addition to her distinguishing signals always carry a riding light on the fore stay similar to other vessels at anchor.

Q. A steamship running is shipping heavy seas, what would you do ?

Ans. Ease the engines, and distribute oil from each bow.

Q. Riding at anchor in a bay, a boat is coming to you, it suddenly comes on to blow which stops the boat from making further progress, what would you do if the boat was only a few yards to leeward ?

Ans. Slack away cable and drift a lifebuoy with a line made fast to it, the boat could then be hauled to the ship.

Q. Where are the ends of the cable made fast ?

Ans. They are generally secured to the keelson at the bottom of the chain locker, or to some other substantial part in the vicinity of the locker.

A modern method is to shackle them together on top of the wooden bulkhead separating the port from the starboard chain locker.

Q. What would you avoid if the propeller was loose ?

Ans. Avoid coming astern.

Q. In measuring for new awnings and tarpaulins, what would you allow for ?

Ans. Stretching in awnings and shrinking in tarpaulins.

Q. Where should the gear for hand pumps be kept ?

Ans. In the carpenter's shop or any handy place where they can be got at immediately when wanted.

Q. What is a four point bearing ?

Ans. Taking the bearing of any stationery object when it is four points on the bow and noting the reading on the log ; doing likewise when the object is right abeam ; the distance run between the bearings is the distance off the object at the second bearing.

Q. A kedge is finished with after having been run away. How would you get it on board ?

Ans. Go off to the kedge with the boat, heave on the buoy rope until the anchor is off the ground, then haul or row the boat back to the ship.

A better way is to heave the kedge home.

Q. A jib or staysail downhaul carries away, what would you do ?

Ans. Send a hand aloft with a rope ; make a bowline with the end of the rope round the stay at the mast head ; reeve the other end through the downhaul block at the tack and haul away. The bowline will catch the head of the sail and have the same effect as if it were made fast to the head cringle.

Q. How are kedge and stream anchors stowed away, and how got ready for use ?

Ans. When not in use the stock is lashed to the shank, and the anchor securely lashed on deck or some convenient place.

To get ready for use the lashings are let go ; the stock (which has the bent end already through the shank) is then brought at right angles with the shank and pushed right up in place and the forelock driven home.

Q. A ship at anchor in a tide way. How would you get a lighter from one side of the ship to the other ?

Ans. Slack away the lighter aft, and bring it round the stern on to the other side of the ship.

In a strong tide it would be folly to attempt to bring it round the stem of the ship.

Q. How do you measure rope and chain ?

Ans. Rope is measured by the circumference and chain by the diameter or thickness of the link (not the breadth).

Second Mates should read the miscellaneous questions for Mates and Masters.

TABLES—WEIGHTS AND MEASURES.

AVOIRDUPOIS.

For all Common Goods.

16 Drams	make	1 Ounce (*oz*)
16 Ounces	. .	1 Pound (*lb*)
14 Pounds	. .	1 Stone
28 Pounds	. .	1 Quarter
4 Quarters (112 lbs.)		1 Hundredweigt (*cwt*)
20 Hundredweight		1 Ton (2240 lbs)

TROY.

For Gold, Silver, and Jewellery, and in Philosophical Experiments.

24 Grains	make	1 Pennyweight (*dwt*)
20 Pennyweights	.	1 Ounce
12 Ounces	. .	1 Pound

The lb. Av. contains 7,000 grs. Troy.

APOTHECARIES.

For mixing and preparing Medical Prescriptions.

20 Grains	make	1 Scruple
3 Scruples	. .	1 Dram
8 Drams	. .	1 Ounce
12 Ounces.	. .	1 Pound

The gr. oz. and lb. are the same as in Troy Weight.

LENGTH.

4 Inches	make	1 Hand
12 Inches	. . .	1 Foot
3 Feet	. . .	1 Yard
6 Feet	. . .	1 Fathom
5½ Yards	. . .	1 Rod, Pole, or Perch
40 Poles (220 yds.)	.	1 Furlong
8 Furlongs (1760 yds)		1 Mile (5280 ft.)
3 Miles	. . .	1 League
2¼ Inches.	. .	1 Nail } *Cloth M.*
4 Nails	. . .	1 Quarter } *Cloth M.*
4 Quarters	. .	1 Yard } *Cloth M.*
5 Quarters	. .	1 Ell
100 Fathoms	. .	1 Cable
10 Cables	. . .	1 Mile
120 Fathoms	. .	Length of ships cable

SURFACE.

144 Square Inches	make	1 Square Foot
9 Square Feet	. .	1 Square Yard
30¼ Square Yards	. .	1 Sq. Rod, Pole, or Perch (*P*)
40 Perches	. . .	1 Rood (*R*)
4 Roods (4840 sq. yds.)		1 Acre (*A*)
640 Acres	. . . .	1 Square Mile

SOLIDITY.

1728 Cubic Inches	make	1 Cubic Foot
27 Cubic Feet	. .	1 Cubic Yard

CAPACITY.

4 Gills	make	1 Pint
2 Pints	. . . .	1 Quart
2 Quarts	. . .	1 Pottle
4 Quarts	. . .	1 Gallon
2 Gallons.	. . .	1 Peck
4 Pecks	. . .	1 Bushel
8 Bushels	. . .	1 Quarter
5 Quarters	. . .	1 Load
3 Bushels	. . .	1 Sack } *Coal Meas.*
12 Sacks	. . . .	1 Chaldron } *Coal Meas.*
A Barrel of *Beer*	contains	36 Gallons
A Hogshead	. . .	54 Gallons
A Hogshead of *Wine*	.	63 Gallons
A Puncheon	. . .	2 Barrels
A Pipe or Butt	. .	2 Hogsheads

TIME.

60 Seconds	make	1 Minute
60 Minutes.	. .	1 Hour
24 Hours	. . .	1 Day
7 Days	. . .	1 Week
4 Weeks	. . .	1 Lunar Month
365 Days	. . .	1 Year

Since 52 Weeks, or 13 Lunar Months, contain 364 Days, these are often reckoned as a Year.

The Year is also divided into 12 Months, called *Calendar Months*, which contain unequal numbers of Days—

January . .	31	May	31	September .	30
February . .	28	June	30	October . .	31
March . . .	31	July , . . .	31	November .	30
April . . .	30	August . . .	31	December .	31

Of these all contain 31 Days, except February, which has 28, and those mentioned in the following rhymes, which have 30 :

Thirty days have September,
April, June, and November.

Every Fourth Year contains 366 Days, and is called Leap-Year ; and in such a year February has 29 Days.

LOG LINE AND GLASS.

Q. What is the use of the log line ?

Ans. To determine the rate of the ship's sailing.

Q. What instrument is always used with the ordinary log ?

Ans. A sand glass.

Q. How do you find the length of knot corresponding to a glass which runs a certain number of seconds ?

Ans. As the seconds in one hour (3600) are to the seconds in a glass, so are the number of feet in a nautical mile (6080) to the number of feet to a knot.

Q. What are the *correct* lengths of a knot for a twenty-eight seconds glass and a thirty seconds glass ?

Ans. Forty-seven feet three and a half inches, and fifty feet eight inches.

Q. Work it out for a 28 second glass ?

Ans. As $\overset{\text{sec.}}{3600} : \overset{\text{sec.}}{28} :: \overset{\text{feet.}}{6080}$: a knot.

```
                6080
                  28
               -----
               48640
              12160
              ------
     3600)170240(47 feet
          14400
          -----
           26240
           25200
           -----
            1040
              12
           -----
     3600)12480(3½ ins.
          10800
          -----
           1680
           ----
```

Q. Would you measure the Log Line to this full length, or more, or less ?

Ans. About 8 or 9 inches less.

Q. Why ?

Ans. So that the ship should not over-run her reckoning.

Q. What length would you mark the Log Line then ?

Ans. For a 28 second glass it would be 46 feet 8 inches, and for a 30 second glass 50 feet.

Q. What is the rule for this; called usually the short rule ?

Ans. To the seconds the glass runs affix a cipher and divide by 6, the quotient is the feet; and if there is a remainder, multiply it by 2 for inches.

Q. Work out this for a 28 second glass ?

Ans. Attach a cipher and it becomes 280.

6)280

feet 46—4
2

8 inches. Answer, 46 feet 8 inches.

Q. Supposing that your Log Line is marked to 46 feet 8 inches, but your glass runs out in 14 seconds; what would you do ?

Ans. I should double the number of knots run out.

Q. If all your glasses should be broken during the voyage ?

Ans. Use a watch with seconds hand.

Q. What stray line would you allow ?

Ans. From twelve to fifteen fathoms.

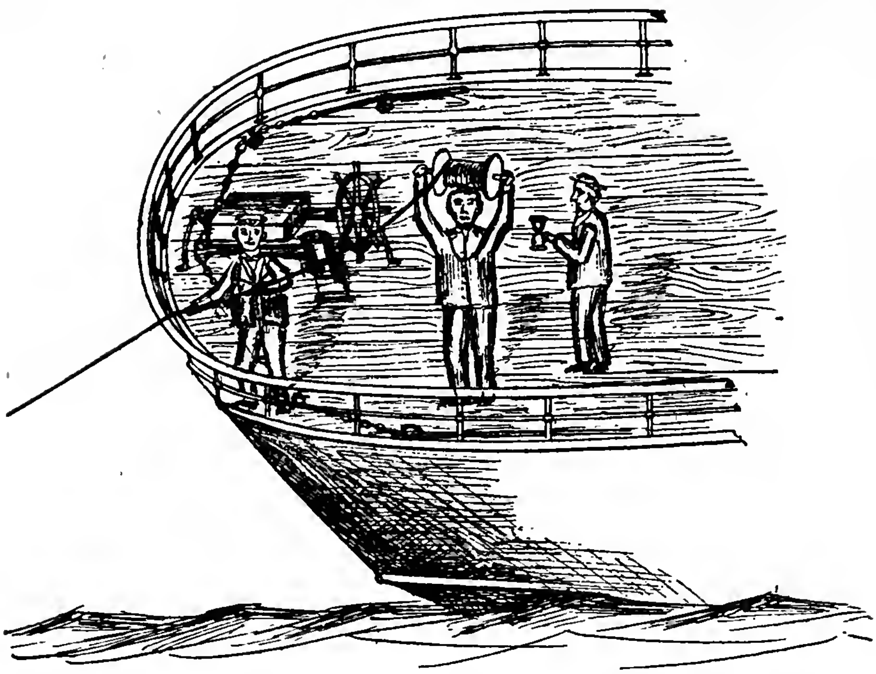
Q. How would you mark a Log Line ?

Ans. After the line was thoroughly stretched, I would mark off the stray line and put a piece of white rag; then mark off the length of a knot and put a piece of leather; at the next knot a piece of cord with two knots; for the third knot a piece of cord with three knots, &c.; between the knots I would put a piece of cord with one knot to indicate the half knots.

Q. How would you heave the Log ?

Ans. Three hands are required, viz. :—Officer of the watch, and two seamen or apprentices. One seaman holds

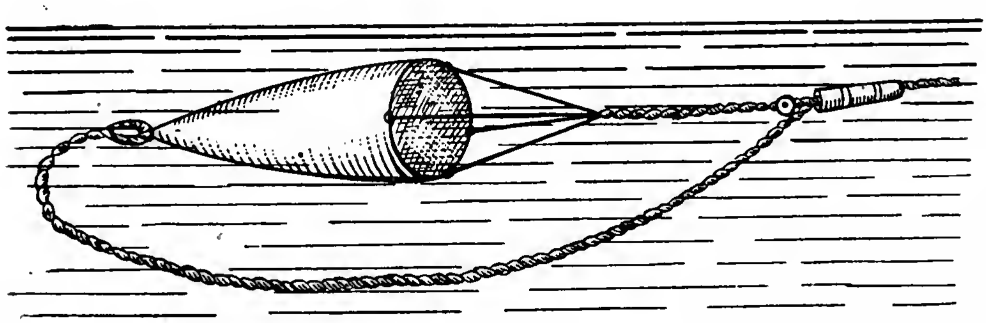
Fig. 9.



HEAVING LOG.

the log reel, the other the sand glass; the officer takes the Log Bag and places the wooden peg in the wooden socket on the line, (see Fig. 10). All three take up their positions on the lee quarter, and the officer draws a few feet of line from the reel, and drops the bag over the stern into the sea; the line begins to run from the reel through the officer's hands, and directly the white rag comes to his hands he calls out *turn* to the man with the glass, who obeys on the instant; the line is now running off the reel at the same rate the ship is sailing, and the sand is running in the glass; the instant the sand runs out of the glass, the man holding it calls *stop*, and the officer immediately stops the line from running further; he looks to see which

Fig. 10.

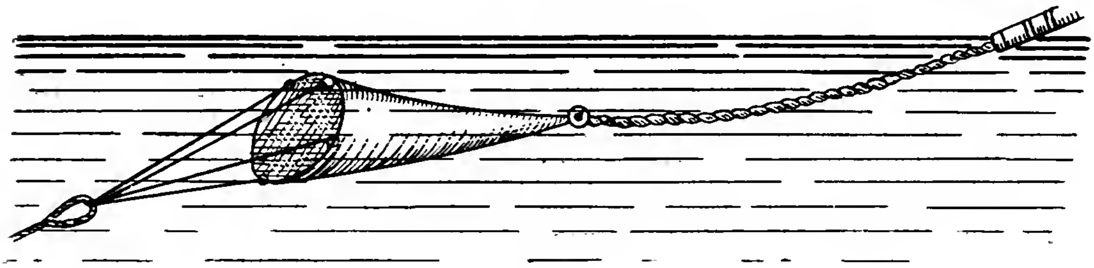


HEAVING LOG.

knots are near his hands, and ascertain the rate the ship is sailing. The line is then jerked to release the peg, the bag capsizes (Fig. 11), and is hauled in over the surface of the sea.

Log ships (Fig. 12) can be used in lieu of log bags.

Fig. 11.



HAULING IN.

LOG REEL, LOG GLASS AND LOG-SHIP.

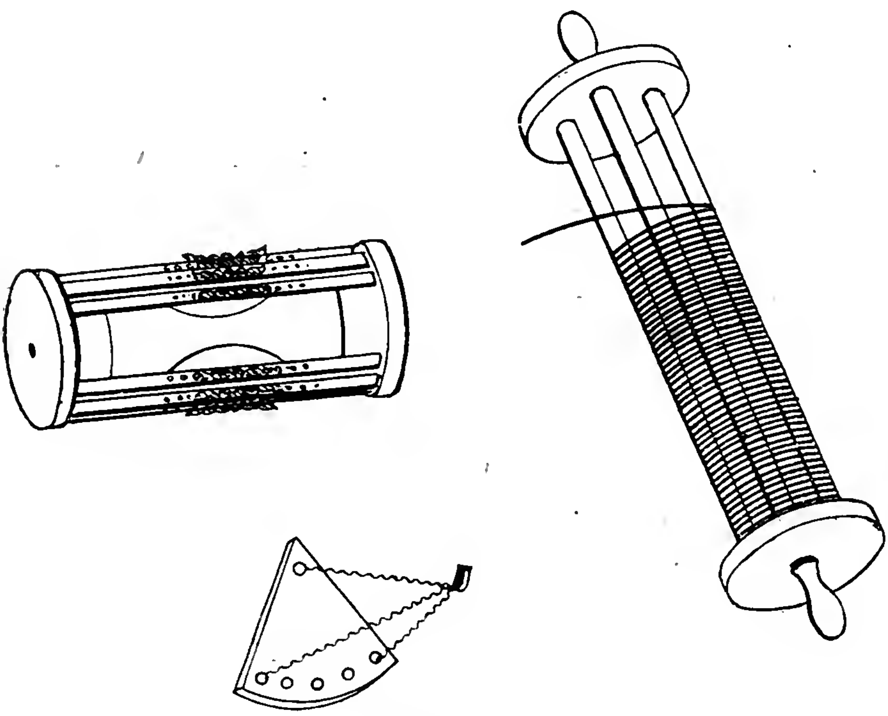


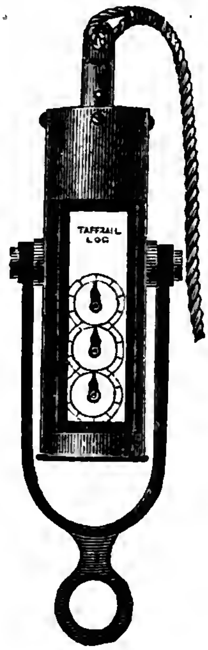
Fig. 12.

PATENT LOGS.

There are various kinds which are now in general use. Some fix on the rail, others tow in the water; they all have dials which indicate the distance run (see Figs. Nos. 2 and 13.)

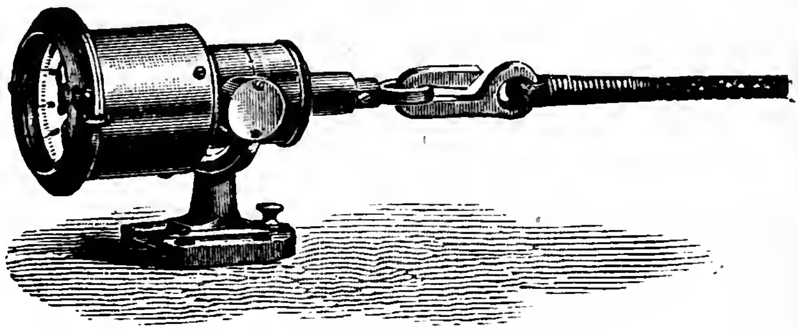
After every passage the various parts should be disconnected and thoroughly cleaned, then lubricated with some fine clear lubricating oil, such as Castor, Colza, Olive, or specially prepared Log oil.

Fig. 13.



BLISS PATENT LOG.

Fig. 14.



WALKER'S PATENT LOG.

LEAD LINE.

Q. How would you mark the Hand Lead Line.

Ans.	At 2 fathoms	-	Leather, with two tails
	3 ,,	-	Leather, with 3 tails
	5 ,,	-	White rag
	7 ,,	-	Red rag
	10 ,,	-	Leather, with a hole in it
	13 ,,	-	Blue Rag
	15 ,,	-	White rag
	17 ,,	-	Red rag
	20 ,,	-	Piece of cord with two knots in it.

There are nine marks and eleven deeps on the Hand Lead Line; the above are the marks, 1, 4, 6, 8, 9, 11, 12, 14, 16, 18 and 19 fathoms being deeps.

Q. How do you mark the Deep Sea Line?

Ans. The same as the Hand Line as far as the 20 fathoms, then for every additional ten fathoms add a knot to the cord, and at every 5 fathoms a piece of cord with one knot only, or a piece of leather, which is better.

Q. On a dark winter's night, with your hands so benumbed with cold that you cannot tell the marks by your touch, what would you do?

Ans. Put it to my lips. If the white be a piece of canvas, the red a piece of bunting, and the blue a piece of cloth, the lips will instantly tell the difference.

Q. How do you heave the Hand Lead ?

Ans. The leadsman takes up a position on the side of ship and holding a small coil in one hand and the lead hanging from the other, he swings the lead backwards and forwards two or three times and when on the forward swing he lets go ; the lead shoots well ahead and the leadsman knows instantly when he finds bottom. He calls out the soundings :—" by the mark 5," " by the deep 8," " a quarter less 6, " and a half 7," " and a quarter 9," &c.

An efficient leadsman swings the lead over his head before he lets go.

Q. How do you heave the Deep Sea Lead ?

Fig. 15.

DEEP SEA LEAD.

Ans. Arm the lead and pass it along the weather side clear of all obstructions as far as the forecastle head. Station a few hands at intervals on the side with small coils of the line in their hands. Get the way off the ship by luffing in a sailing ship and easing the engines in a steamship. When ready, give the order to *heave* ; the hand on the forecastle heaves and calls out " Watch there Watch," the others stationed on the side with the small coils do likewise one after the other. The officer who is stationed aft, feels the lead on the bottom as the ship passes and notes the mark on the surface of the water

Q. What do you mean by " Arming " or " Priming " the lead ?

Ans. Filling the hollow at the bottom of the lead with tallow, so that when the lead is hauled up, the nature of the sea bottom will be secured and shown on the tallow.

Q. What is the weight of the hand lead ?

Ans. From 7 to 14 lbs.

Q. What is the weight of the deep sea lead ?

Ans. 28 lbs.

Q. How would you secure the line to the lead ?

Ans. The lead has a grummet at the upper end, through which the eye at the end of the line is rove and the lead passed through the eye ; the parts are then rendered tight.

PATENT LEAD OR SOUNDING MACHINE.

There are various kinds, the principle of which are all the same, viz.—The water pressure has the effect of indicating the depth in fathoms on the instrument itself ; some have small glass tubes coated inside with a chemical preparation of a light salmon colour (chromate of silver).

The salt water forced upon the tube by pressure converts the pink colour to milky white. The tube is then placed on a boxwood scale which gives the depth in fathoms.

The instrument fits into a protecting case which is secured to a very fine steel wire. A sinker is also made fast to the end of the wire ; the sinker can be armed the same as the ordinary lead. The wire is reeled round the barrel of a special winch for lowering and heaving in ; the winch generally has a line measurer which indicates the line run out, and is also fitted with a brake for controlling the speed.

Q. How do you take a cast with a Patent Lead ?

Ans. Make fast the sinker (armed) and instrument to the

PATENT LEAD.

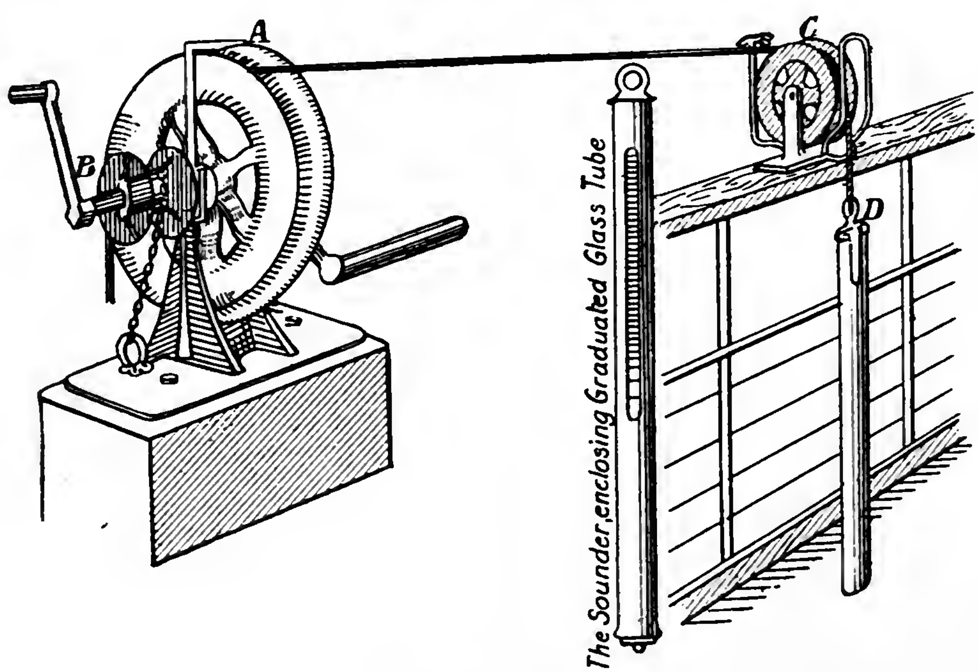


Fig. 16.

wire, see the winch ready, put the wire in the fair lead and lower away over the quarter, regulating the speed with the winch. When the sinker finds bottom heave away on the winch, the arming on the sinker will show the nature of the sea bottom and the instrument the depth in fathoms.

NOTE.—The length of line run out has nothing to do with the depth.

STOWAGE OF CARGOES.

Q. What is dunnage ?
Ans. Loose wood or other substances laid at the bottom of a ship.

NOTE.—The following rules as to dunnage relate mostly to ordinary ships, and not to cellular bottoms.

Q. What is it for ?
Ans. To prevent damage to the cargo if the ship should leak.

Q. What part would you dunnage ?
Ans. The floors, bilges, pump-well, masts, and in the wake of the chain plates, scuppers, hooks, and transoms.

Q. What dunnage would you allow for a general cargo ?
Ans. 9 inches on the floors to 14 at the upper part of the bilges, and $2\frac{1}{2}$ inches in the sides.

Q. Suppose the cargo were bale goods ?
Ans. 9 inches on the floors and to the upper part of the bilges, and $2\frac{1}{2}$ at the side. The wing bales of the second tier to be kept 6 inches off the sides at the lower corner.

Q. Bags of coffee or cocoa ?
Ans. 9 inches on floors, 14 to upper part of bilges, and $2\frac{1}{2}$ at the sides.

Q. Guano ?
Ans. Two to three feet. Over the dunnage a tier of bags fore and aft, and, if possible, a second tier so laid as to cover the cantlines of the first; and bags to be built up the sides, around the mast casings, &c.

Q. How do you stow bar or railway iron ?
Ans. Fore and aft till level with the keelson, then grating fashion.

Q. How would you protect the sides of your ship ?
Ans. By laying bars fore and aft along the sides.

Q. How do you secure it?
Ans. By laying the last three tiers solid, and shoring, lashing, and wedging the lot well down.

Q. How do you stow bale goods?
Ans. On their flats amidships, marks and numbers up, on their edges in the wings, marks and numbers inboard.

Q. Why would you stow the wing bales on their edges?
Ans. So that in the case of leakage only that part of the bale next the side of the ship would be damaged.

Q. How would you stow cases?
Ans. Marks and numbers up.

Q. How would you stow a general cargo?
Ans. Marks and numbers up.

Q. Where would you stow oil, resin, pitch, tar, &c.?
Ans. In the fore hold.

Q. Where carboys of acids?
Ans. On deck.

Q. Why?
Ans. Ready to throw overboard if there is risk of breakage.

Q. How do you stow casks?
Ans. Fore and aft. Bung up and bilge free, good cross beds at the quarters, and well chocked with wood.

Q. How could you find the bung of a dirty cask?
Ans. The rivets of the hoops are in line with the bung.

Q. Why are casks stowed bung up?
Ans. To prevent leak, and because it is the strongest way of the casks; the head-pieces are put in so that they are up and down when the cask is bung up.

Q. How many heights are you allowed to stow?
Ans. 3 of pipes or butts, 4 of puncheons, 6 of hogsheads, and 8 of barrels.

O. How would you stow a single cask?
Ans. With 3 inches of soft wood bed under each quarter and quoins on the beds on each side.

Q. If stowing a cargo of casks, how would you stow the ground tier?
Ans. Bilge and bilge. (See *b*, Fig. 17.)

Q. The first upper tier?
Ans. In the cantlines (*a* Fig. 17) of the ground tiers, with quoins under the quarters at each side.

NOTE.—When stowing wines, planks should be laid over every tier for the quarters of the barrels above to rest on.

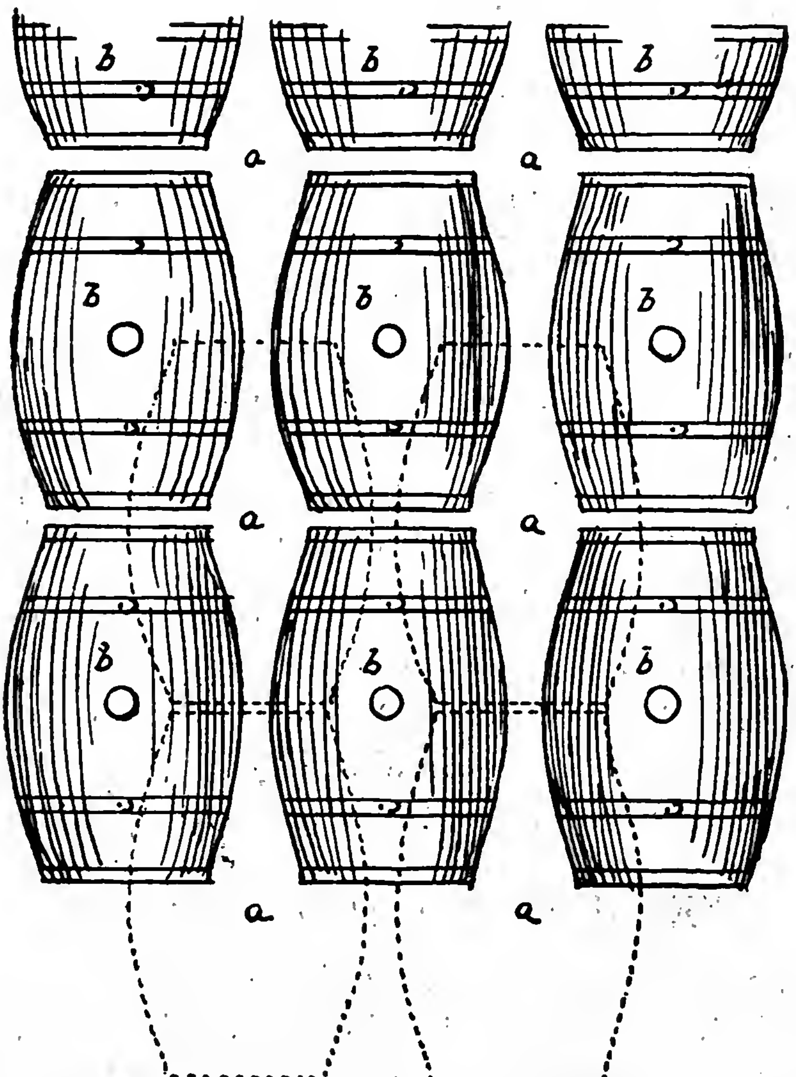
Q. Where would you stow valuable goods ?
Ans. Near the officers' berths and away from the crew.

Q. In stowing bags of flour, what would you guard against ?
Ans. Placing them against stanchions, brackets, edges of stiffeners on bulkheads, &c.

Q. In stowing baulks of timber, what should you be careful about ?
Ans. To see that the ends and sides are well chocked off.

Q. How do you secure this cargo when all in ?
Ans. With tom shores under the beams.

Fig. 17.



STOWING CASKS.

Q. What dunnage do you allow for grain ?
Ans. Not less than 10 inches on the floors and 14 in the bilges, and the hold to be matted.

Q. How would you lay the mats ?
Ans. Begin in the midships both on floor and sides, and work forward and aft, and overlap about one-third

Q. Describe how you would take in a chest of gold ?
Ans. I would make a rope net bag, each part of the rope being capable of holding the weight of the chest. Place the chest in this bag, with a line also attached to the chest. The bag must have a buoy and a buoy line.

Q. Prepare a hold for dry cargo ?
Ans. The hold must be thoroughly swept, well aired, dried, dunnaged, and matted ; double mats where the ship is liable to strain, and see that the limbers are clear.

Q. How do you lay dunnage ?
Ans. Athwartship underneath and fore and aft on top.

Q. Why athwartship underneath ?
Ans. To allow a free water course when the ship is rolling, should the water get above the ceiling,

Q. How do you tell when casks are bilge free ?
Ans. By feeling with the hand.

Q. Where do you stow gunpowder ?
Ans. In a properly constructed magazine in or near the hatchway.

Q. In a steamship, you have to stow a general cargo, including barrels of paraffin and turpentine, what precaution would you take ?
Ans. I would stow the paraffin and turpentine, in separate holds from any cargo that would spoil by absorbing the fumes, such as rice, grain, tea, flour, etc.

Q. How many tarpaulins should you have on the hatches?
Ans. Two at the least, three are better, best ones on top.

TENDING SHIP IN A TIDEWAY.

Q. What do you mean by lee tide ?
Ans. Wind and tide in the same direction.

Q. What do you mean by weather tide ?
Ans. Wind and tide in opposite directions.

Q. What position would a ship take in a case of lee tide if she were left alone with the helm amidships ?
Ans. She would sheer about with the anchor first on one bow then on the other.

Q. What would you do to keep her steady ?
Ans. Give her a slight sheer with the helm.

Q. Wind and tide right ahead (lee tide) how would you sheer your ship ?
Ans. Either to port or starboard, with the anchor about a point on the bow.

Q. How would you trim the yards ?
Ans. Brace the fore yards aback and point the main.

Q. Why the fore yards aback ?
Ans. To help to keep the sheer.

Q. Suppose the wind was very strong ?
Ans. Point all the yards.

Q. If there should be a shoal on either side of you, how would you sheer the ship ?
Ans. Towards the shoal.
Q. Why ?
Ans. Because if she broke her sheer, she would go from the danger.
Q. You want to get ready for the weather tide, what would you do ?
Ans. Give the ship a broader sheer with the helm, and hoist the foretopmast staysail (sheet to windward) before the tide is done.

Q. Why would you hoist the foretopmast staysail ?
Ans. To keep the sheer during slack water when the helm is of no use.

Q. Is there anything else will help to keep the sheer ?
Ans. Yes. The fore yards which are already aback.

Q. What will occur after slack water ?
Ans. The tide will begin to make in the opposite direction to the lee tide which will be the weather tide now.

Q. What effect will it have on the ship ?
Ans. The tide catching the ship under the quarter with the help of the wind on the other bow, will swing the ship athwart the wind and tide. Fill on all the yards, and shift the staysail sheet to leeward, the ship will now forge ahead

and tighten the cable and the tide on the lee beam will swing the ship over the cable ; steady her with the helm. The ship wiil now take up a position with the anchor on her lee quarter and the tide a little on her lee bow, which is the position the ship will lay during the weather tide, so long as the wind remains stronger than the tide.

Q. How will you trim the yards ?

Ans. Brace the main yards by and point the fore, if the wind be strong ; but if the wind be light, keep the yards square.

Q. Suppose the ship remains in her proper position during the weather tide, what will she do when the tide is finished ?

Ans. Turn round head to wind and be ready for the lee tide.

Q. Suppose during the weather tide the wind falls light, and the tide becomes stronger than the wind, what will the ship do ?

Ans. Drop astern, and be tide rode to windward of the anchor.

Q. What would be the safest thing to do in the above case at slack water ?

Ans. Heave short, then pay your cable out again when the ship is on the lee side of the anchor.

Note.—In a case of weather tide always sheer the ship with the anchor on the lee quarter.

WIND ACROSS THE TIDE.

Q. How will you sheer a ship, wind across the tide ?

Ans. To leeward, with everything aback ; tide a little on the weather bow, anchor about six points on the weather bow.

Q. How long would the ship lie in this position ?

Ans. Until slack water.

Q. What would she do at slack water ?

Ans. Swing head to wind.

Q. What would you do ?

Ans. Turn the yards round.

Q. How long will the ship remain head to wind ?

Ans. Until the next tide catching her on the broad side, swings her round with the wind on the other side, she will lie again in a similar position as before, with the anchor about six points on the weather bow and the tide a little on the weather bow.

Note.—Loaded ships will as a rule lie best to windward of their anchor.

SHORT RULES FOR SINGLE ANCHOR.

Lee Tide.

Ship with a slight sheer, anchor, wind and tide a little on the bow.

Weather Tide.

Ship with a sheer, anchor on lee quarter, tide a little on lee bow.

Wind Across Tide.

Ship to leeward with everything aback; anchor about six points on weather bow, and tide a little on same bow.

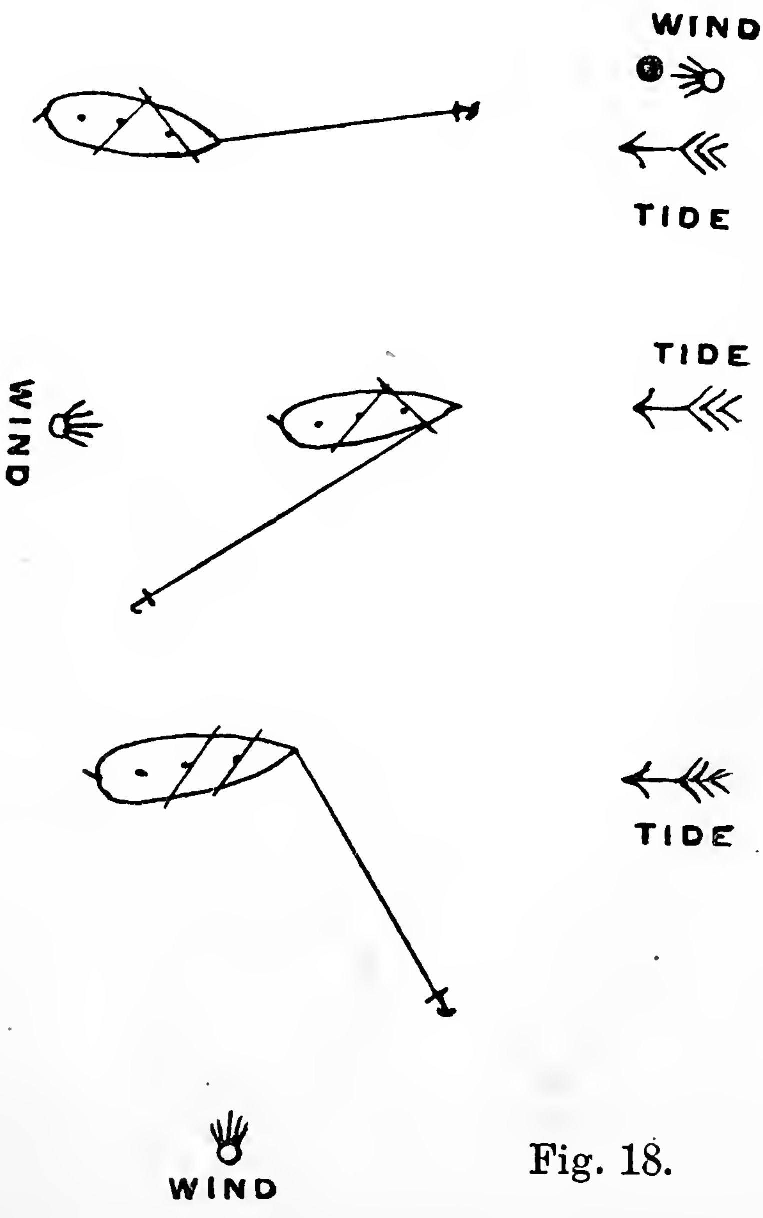


Fig. 18.

REGULATIONS FOR PREVENTING COLLISIONS AT SEA, 1897.

Preliminary.

These Rules shall be followed by all vessels upon the high seas and in all waters connected therewith, navigable by sea-going vessels.

In the following Rules every steam vessel which is under sail and not under steam is to be considered a sailing vessel, and every vessel under steam, whether under sail or not, is to be considered a steam vessel.

The word "steam vessel" shall include any vessel propelled by machinery.

A vessel is "under way" within the meaning of these Rules when she is not at anchor, or made fast to the shore or aground.

Rules concerning Lights, &c.

The word "visible" in these Rules, when applied to lights, shall mean visible on a dark night with a clear atmosphere.

Article 1.—The Rules concerning lights shall be complied with in all weathers from sunset to sunrise, and during such time no other lights which may be mistaken for the prescribed lights shall be exhibited.

Steamships under way.

Art. 2.—A steam vessel when under way shall carry—

(*a*.) On or in front of the foremast, or if a vessel without a foremast, then in the fore part of the vessel, at a height above the hull of not less than **20** feet, and if the breadth of the vessel exceeds **20** feet, then at a height above the hull of not less than such breadth, so, however, that the light need not be carried at a greater height above the hull than **40** feet, a bright **white** light so constructed as to show an unbroken light over an arc of the horizon of **20** points of the compass, so fixed as to throw the light **10** points on each side of the vessel, viz. ; from right ahead to **2** points abaft the beam on either side, and of such a character as to be visible at a distance of at least **5** miles.

(*b*.) On the starboard side a **green** light so constructed as to show an unbroken light over an arc of the horizon of **10** points of the compass, so fixed as to throw the light from right ahead to 2 points abaft the beam on the starboard side, and of such a character as to be visible at a distance of at least 2 miles.

(*c.*) On the port side a **red** light so constructed as to show an unbroken light over an arc of the horizon of 10 points of the compass, so fixed as to throw the light from right ahead to 2 points abaft the beam on the port side, and of such a character as to be visible at a distance of at least 2 miles.

(*d.*) The said **green** and **red** side lights shall be fitted with inboard screens projecting at least 3 feet forward from the light, so as to prevent these lights from being seen across the bow.

(*e.*) A steam vessel when under way may carry an **additional white** light similar in construction to the light mentioned in subdivision (*a*). These two lights shall be so placed in line with the keel that one shall be at least 15 feet higher than the other, and in such a position with reference to each other that the lower light shall be forward of the upper one. The vertical distance between these lights shall be less than the horizontal distance.

Steamships Towing.

ART. 3.—A steam vessel, when towing another vessel, shall, in addition to her side lights, carry **two bright white** lights in a vertical line one over the other, not less than **six** feet apart; and when towing more than one vessel, shall carry an **additional** bright **white** light 6 feet above or below such lights, if the length of the tow, measuring from the stern of the towing vessel to the stern of the last vessel towed exceeds 600 feet. Each of these lights shall be of the same construction and character, and shall be carried in the same position as the **white** light mentioned in Article 2 (*a*), except the additional light, which may be carried at a height of not less than 14 feet above the hull.

Such steam vessel may carry a **small white** light abaft the funnel or aftermast for the vessel towed to steer by, but such light shall not be visible forward of the beam.

Vessels Not Under Command and Laying Cables.

ART. 4.—(*a*) A vessel which, from any accident is not under command, shall carry at the same height as the white light mentioned in Art. 2 (*a*), where they can best be seen; and, if a steam vessel, in lieu of that light, **two red** lights in a vertical line one over the other, not less than **six** feet apart, and of such a character as to be visible all round the horizon at a distance of at least **2** miles; and shall by day carry in a vertical line one over the other, not less than **six** feet apart, where they can best be seen, **two black balls** or shapes, each **2** feet in diameter.

(*b*) A vessel employed in laying or in picking up a telegraph cable shall carry in the same position as the white light mentioned in Article 2 (*a*), and, if a steam vessel, in lieu of that light, **three** lights in a vertical line one over the other, not less than **6** feet apart. The **highest** and **lowest** of these lights shall be **red**, and the **middle** light shall be **white**, and they shall be of such a character as to be visible all round the horizon, at a distance of at least **2** miles. By day she shall carry in a vertical line one over the other not less than **6** feet apart, where they can best be seen, **three** shapes not less than **2** feet in diameter, of which the **highest** and **lowest** shall be globular in shape and **red** in colour, and the **middle** one diamond in shape and **white**.

(*c*) The vessels referred to in this Article, when not making way through the water, shall not carry the side lights, but when making way shall carry them.

(*d*) The lights and shapes required to be shown by this Article are to be taken by other vessels as signals that the vessel showing them is not under command and cannot therefore get out of the way.

These signals are not signals of vessels in distress and requiring assistance. Such signals are contained in Article 31.

Sailing Ships Under Way and any Vessel being Towed.

Art. **5**.—A sailing vessel under way and any vessel being towed, shall carry the **same** lights as are prescribed by Article 2 for a steam vessel under way, with the exception of the white light mentioned therein, which they shall never carry.

Small Vessels in Bad Weather.

Art. **6**.—Whenever, as in the case of small vessels under way during bad weather, the green and red side lights cannot be fixed, these lights shall be **kept** at hand **lighted** and ready for use; and shall on the approach of or to other vessels, be **exhibited** on their respective sides in sufficient time to prevent collision, in such manner as to make them most visible, and so that the green light shall not be seen on the port side nor the red light on the starboard side, nor, if practicable, more than 2 points abaft the beam on their respective sides.

To make the use of these portable lights more certain and easy, the lanterns containing them shall each be painted outside with the colour of the light they respectively contain, and shall be provided with proper screens.

Small Steam Vessels and Vessels under Oars or Sails.

ART. **7**.—Steam vessels of less than **40**, and vessels under oars or sails of less than **20** tons gross tonnage respectively, and rowing boats, when under way, shall not be obliged to carry the lights mentioned in Article 2 (*a*) (*b*) and (*c*), but if they do not carry them they shall be provided with the following lights :—

1. Steam vessels of less than **40** tons shall carry :

(*a*.) In the fore part of the vessel, or on or in front of the funnel, where it can best be seen, and at a height above the **gunwale** of not less than **9** feet, a bright **white** light constructed and fixed as prescribed in Article 2 (*a*), and of such a character as to be visible at a distance of least **2** miles.

(*b*.) **Green** and **red** side-lights constructed and fixed as prescribed in Article 2 (*b*) and (*c*), and of such a character as to be visible at a distance of at least **1** mile, or a combined lantern showing a **green** light and a **red** light from right ahead to **2** points abaft the beam on their respective sides. Such lantern shall be carried not less than **3** feet below the **white** light.

2. Small steamboats, such as are carried by sea-going vessels, may carry the white light at a **less** height than **9** feet above the **gunwale**, but it shall be carried **above** the combined lantern, mentioned in subdivision 1 (*b*).

3. Vessels under oars or sails, of less than **20** tons, shall have **ready** at hand a lantern with a **green** glass on one side and a **red** glass on the other, which on the

approach of or to other vessels, shall be **exhibited** in sufficient time to prevent collision, so that the green light shall **not** be seen on the port side **nor** the red light on the starboard side.

4. Rowing boats, whether under oars or sails, shall have ready at hand a lantern showing a **white** light, which shall be temporarily exhibited in sufficient time to prevent collision.

The vessels referred to in this Article shall not be obliged to carry the lights prescribed by Article 4 (*a*) and Article 11, last paragraph.

Pilot Vessels (Sail and Steam).

Art. **8**. Pilot vessels, when engaged on their station on pilotage duty, shall not show the lights required for other vessels, but shall carry a **white** light at the masthead, visible all round the horizon, and shall also exhibit a **flare-up** light or flare-up lights at short intervals, which shall never exceed **fifteen** minutes.

On the near approach of, or to other vessels, they shall have their side-lights lighted, **ready** for use, and shall **flash** or **show** them at **short** intervals, to indicate the direction in which they are heading, but the green light shall **not** be shown on the port side, **nor** the red light on the starboard side.

A pilot-vessel of such a class as to be obliged to go alongside of a vessel to put a pilot on board, may **show** the white light instead of carrying it at the masthead, and may instead of the coloured lights above-mentioned, have at **hand** ready for use a **lantern** with a green glass on the one side and a red glass on the other, to be used as prescribed above.

A **steam** pilot-vessel exclusively employed for the service of pilots licensed or certified by any pilotage authority or the Committee of any pilotage district, when engaged on her station on pilotage duty and not at anchor, shall, in **addition** to the lights required for all pilot boats carry at a distance of **eight** feet below her **white** masthead light a **red** light visible all round the horizon and of such a character as to be visible on a dark night with a clear atmosphere at a distance of at least **two** miles, and also the coloured **side-lights** required to be carried by vessels when under way.

When engaged on her station on pilotage duty and at **anchor** she shall carry, in addition to the lights required for all pilot boats, the **red** light above mentioned, but **not** the coloured side-lights.

Pilot vessels when not engaged on their station on pilotage duty, shall carry lights similar to those of other vessels of their tonnage.

LIGHTS AND SIGNALS OF FISHING VESSELS.

ART. **9***†.—Fishing-vessels and fishing-boats, when under way and when not required by this Article to carry or show the lights hereinafter specified, shall carry or show the lights prescribed for vessels of their tonnage under way.

(*a*) Open boats, by which is to be understood boats not protected from the entry of sea water by means of a continuous deck, when engaged in any fishing at night, with outlying tackle extending **not more** than **150** feet horizontally from the boat into the seaway, shall carry one all-round white light.

Open boats, when fishing at night, with outlying tackle extending **more** than **150** feet horizontally from the boat into the seaway, shall carry **one** all-round white light, and in addition on **approaching** or **being** approached by other vessels, shall **show** a second **white** light at least **3** feet below the first light and at a horizontal distance of at least **5** feet away from it in the direction in which the outlying tackle is attached.

‡ (*b*) Vessels and boats, except open boats as defined in sub-division (*a*), when fishing with **drift nets,** shall, so long as the nets are wholly or partly in the water, carry **two white** lights where they can best be seen. Such lights shall be placed so that the vertical distance between them shall be not less than **6** feet and more than **15** feet, and so that the horizontal distance between them, measured in a

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* This article does not apply to Chinese or Siamese vessels.

† The expression "Mediterranean Sea" contained in sub-sections (*b*) and (*c*) of this article includes the Black Sea and the other adjacent inland seas in communication with it.

‡ Dutch vessels and boats when engaged in the "kol," or hand-line fishing will carry the lights prescribed for vessels fishing with drift nets.

line with the keel, shall not be less than **5** feet and not more than **10** feet. The **lower** of these two lights shall be in the direction of the nets, and both of them shall be of such a character as to show all round the horizon, and to be visible at a distance of not less than **3** miles.

§ Within the Mediterranean Sea, and in the seas bordering the coasts of Japan and Korea, sailing fishing vessels of **less** than **20** tons gross tonnage shall **not** be obliged to carry the lower of these two lights; should they, however, not carry it, they shall show in the same position (in the direction of the net or gear) a **white** light, visible at a distance of not less than **one sea** mile, on the **approach** of or to other vessels.

(*c*) Vessels and boats, except open boats as defined in sub-division (*a*), when **line fishing** with their lines out and attached to or hauling their lines, and when not at anchor or stationary within the meaning of sub-division (*h*), shall **carry** the **same** lights as vessels fishing with drift nets. When shooting lines, or fishing with towing lines, they shall carry the lights prescribed for a steam or sailing vessel under way respectively.

Within the Mediterranean Sea, and in the seas bordering the coast of Japan and Korea, sailing fishing vessels of **less** than **20** tons gross tonnage shall not be obliged to carry the lower of these two lights; should they, however, not carry it, they shall **show** in the same position (in the direction of the lines) a **white** light, visible at a distance of not less than **one sea** mile on the approach of or to other vessels.

(*d*) Vessels, when engaged in trawling, by which is meant the dragging of an apparatus along the bottom of the sea.

1. If steam-vessels, shall carry in the **same** position as the white light mentioned in Article (*a*), a **tricoloured** lantern so constructed and fixed as

§ Also, as regards Russian vessels, in the seas (excluding the Baltic) bordering on the coasts of Russia.

to show a **white** light from right ahead to **two** points on each bow, and a **green** light and a **red** light over an arc of the horizon from **two** points on each bow to **two** points abaft the beam on the starboard and port sides respectively; and not less than **6** nor more than **12** feet below the tri-coloured lantern a **white** light in a lantern so constructed as to show a clear uniform and unbroken light all round the horizon.

2. If sailing vessels, shall carry a **white** light in a lantern, so constructed as to show a clear uniform and unbroken light all round the horizon, and shall also, on the approach of or to other vessels, **show** where it can best be seen a white **flare-up** light or torch in sufficient time to prevent collision.

All lights mentioned in sub-division (*d*) 1 and 2 shall be visible at a distance of at least 2 miles.

(*e*) Oyster dredgers and other vessels fishing with dredge-nets shall carry and show the same lights as trawlers.

(*f*) Fishing vessels and fishing boats may at any time use a **flare-up** light in addition to the lights which they are by this Article required to carry and show, and they may also use working lights.

(*g*) Every fishing-vessel and every fishing-boat under **150** feet in length, when at anchor, shall exhibit a **white** light visible all round the horizon at a distance of at least one mile.

Every fishing vessel of **150** feet in length or upwards, when at anchor, shall exhibit a **white** light visible all round the horizon at a distance of at least **one** mile, and shall exhibit a second light as provided by vessels of such length by Article 11.

Should any such vessel, whether **under** 150 feet in length, or of 150 feet in length or **upwards,** be attached to a net or other fishing gear, she shall on the **approach** of other vessels **show** an additional **white** light at least **3** feet below the anchor light, and at a horizontal distance of at least **5** feet away from it in the direction of the net or gear.

(*h*) If a vessel or boat when fishing becomes stationary in consequence of her gear getting **fast** to a **rock** or other obstruction, she shall in daytime **haul** down the day-signal required by sub-division (*k*); at night **show** the light or lights prescribed for a vessel at anchor; and during fog, mist, falling snow, or heavy rain-storms make the signal prescribed for a vessel at anchor. (See sub-division (*d*), and the last paragraph of Article 15.)

(*i*) In fog, mist, falling snow or heavy rainstorms, drift net vessels attached to their nets, and vessels when trawling, dredging, or fishing with any kind of drag-net, and vessels line fishing with their lines out, shall, if of **20** tons gross tonnage or **upwards**, respectively, at intervals of not more than **one minute** make a **blast**; if steam-vessels, with the whistle or syren, and if sailing-vessels with the fog-horn; each **blast** to be **followed** by ringing the **bell.** Fishing vessels and boats of **less** than 20 tons gross tonnage shall not be obliged to give the above mentioned signals; but if they do not, they shall make some other **efficient** sound signal at intervals of not more than **one minute.**

(*k*) All vessels or boats fishing with nets or lines or trawls, when under way, shall in daytime indicate their **occupation** to an approaching vessel by displaying a **basket** or other efficient signal where it can best be seen. If vessels or boats at anchor have their gear out, they shall, on the approach of other vessels, **show** the same signal on the side on which those vessels can pass.

The vessels required by this Article to carry or show the lights hereinbefore specified shall not be obliged to carry the lights prescribed by Article 4 (*a*), and the last paragraph of Article 11.

This Article shall be read and construed as part of the Regulations contained in Schedule I. to the Order of Council under Section 418 of the Merchant Shipping Act, 1894, made the 27th day of November, 1896, and as if it had formed one of such Regulations and been numbered 9 among the Articles containing the same.

Vessels being Overtaken.

Art. 10.—A vessel which is being overtaken by another shall **show** from her stern to such last-mentioned vessel a white light or a flare-up light.

The white light required to be shown by this Article **may** be fixed and carried in a lantern, but in such case the lantern shall be so constructed, fitted, and screened that it shall throw an unbroken light over an arc of the horizon of **12** points of the compass, viz., for **6** points from right aft on each side of the vessel, so as to be visible at a distance of at least **1** mile. Such light shall be carried as nearly as practicable on the same **level** as the side lights.

Vessels at Anchor.

Art. 11.—A vessel **under 150** feet in length, when at anchor, shall carry forward, where it can best be seen, but at a height not exceeding **20** feet above the hull, a **white** light in a lantern so constructed as to show a clear, uniform, and unbroken light visible all round the horizon at a distance of at least **1** mile.

A vessel of **150** feet or **upwards** in length, when at anchor, shall carry in the forward part of the vessel, at a height of not less than **20,** and not exceeding **40** feet above the hull, one such light, and **at** or near the stern of the vessel, and at such a height that it shall not be less than **15** feet lower than the forward light, another such light.

The length of the vessel shall be deemed to be the length appearing in her certificate of registry.

A vessel aground in or near a fairway shall carry the above light or lights and the **two red** lights prescribed by Article 4 (*a*).

Flare-up, &c.. Signals.

Art. 12.—Every vessel may, if necessary, in order to **attract** attention, in addition to the lights which she is by these Rules required to carry, **show** a flare-up light or use any detonating signal that cannot be mistaken for a distress signal.

Special Signal Lights.

Art. **13**.—Nothing in these Rules shall interfere with the operation of any special rules made by the Government of any nation with respect to additional station and signal lights for two or more ships of war or of vessels sailing under convoy, or with the exhibition of recognition signals adopted by shipowners, which have been authorised by their respective Governments and duly registered and published.

Steamships under Sail only.

Art. 14.—A steam vessel proceeding under sail only, but having her funnel up, shall carry in daytime, **forward,** where it can best be seen, **one black ball** or shape **2** feet in diameter.

Sound Signals for Fog, &c.

Art. **15**.—All signals prescribed by this Article for vessels under way may be given :

1. By "steam vessels" on the **whistle** or **siren.**

2. By "sailing vessels and vessels towed" on the **fog horn.**

The words "prolonged blast" used in this article, shall mean a blast from **4** to **6** seconds duration.

A steam vessel shall be provided with an efficient **whistle** or **siren,** sounded by steam or some other substitute for steam, so placed that the sound may not be intercepted by any obstruction, and with an efficient **fog horn**, to be sounded by mechanical means, also with an efficient bell.* A sailing vessel of **20** tons gross tonnage or upwards shall be provided with a similar fog horn and bell.

In fog, mist, falling snow, or heavy rain storms, whether by day or night, the signals described in this Article shall e used as follows, viz :—

(*a.*) A steam vessel having way upon her, shall sound, at intervals of not more than **2** minutes, a **prolonged** blast.

(*b.*) A steam vessel under way, but **stopped** and having no way upon her, shall sound, at intervals of not

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* In all cases where the Rules require a bell to be used a drum may be substituted on board Turkish vessels, or a gong where such articles are used on boa.d small sea-going vessels.

more than 2 minutes, 2 prolonged blasts, with an interval of about 1 second between them.

(*c.*) A sailing-vessel under way shall sound, at intervals of not more than **one** minute, when on the **starboard** tack **one** blast, when on the **port** tack **two** blasts in succession, and when with the wind **abaft** the beam, **three** blasts in succession.

(*d.*) A vessel, when at anchor, shall, at intervals of not not more than **one** minute, ring the bell **rapidly** for about **five** seconds.

(*e.*) A vessel, when towing, a vessel employed in laying or in picking up a **telegraph** cable, and a vessel under way, which is **unable** to get out of the way of an approaching vessel through being not under command, or **unable** to manœuvre as required by these Rules, shall, instead of the signals prescribed in subdivisions (*a*) and (*c*) of this Article, at intervals of not more than 2 minutes, sound **three** blasts in succession, viz.: **one** prolonged blast followed by **two** short blasts. A vessel towed may give this signal, and she shall not give any other.*

Sailing vessels and boats of less than 20 tons gross tonnage shall not be obliged to give the above-mentioned signals, but if they do not, they shall make some other efficient sound signal at intervals of not more than 1 minute.

Speed of Ships to be moderate in Fog, &c.

Art. 16.—Every vessel shall, in a fog, mist, falling snow or heavy rain storms, go at a **moderate** speed, having careful regard to the existing circumstances and conditions.

A steam vessel hearing, apparently forward of her beam, the fog signal of a vessel, the position of which is not ascertained, shall, so far as the circumstances of the case admit, **stop** her engines, and then navigate with caution until danger of collision is over.

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* Dutch steam pilot-vessels, when engaged on their station on pilotage duty in fog, mist, falling snow, or heavy rain storms are required to make at intervals of 2 minutes at most one long blast with the siren, followed after 1 second by a long blast with the steam whistle and again after 1 second by a long blast on the siren. When not engaged on their station on pilotage duty, they make the same signals as other steamships.

Steering and Sailing Rules.

Preliminary.—Risk of Collision.

Risk of collision can, when circumstances permit, be ascertained by carefully **watching** the compass bearing of an approaching vessel. If the bearing does **not** appreciably change, such risk should be deemed to exist.

Two Sailing Ships Approaching.

Art. **17**.—When two sailing-vessels are approaching one another, so as to involve risk of collision, one of them shall keep out of the way of the other as follows, viz. :—

(*a.*) A vessel which is running **free** shall keep out of the way of a vessel which is **close hauled**.

(*b.*) A vessel which is close hauled on the **port** tack shall keep out of the way of a vessel which is close hauled on the **starboard** tack.

(*c.*) When both are running free, with the wind on **different** sides, the vessel which has the wind on the **port** side shall keep out of the way of the other.

(*d.*) When both are running free with the wind on the **same** side, the vessel which is to **windward** shall keep out of the way of the vessel which is to leeward.

(*e.*) A vessel which has the wind **aft** shall keep out of the way of the other vessel.

Two Steamships Meeting end on.

Art. **18**.—When two steam vessels are meeting **end** on, or nearly end on, so as to involve risk of collision, each shall alter her course to **starboard**, so that each may pass on the **port** side of the other.

This article only applies to cases where vessels are meeting end on, or nearly end on, in such a manner as to involve risk of collision, and does **not** apply to two vessels which must, if both keep on their respective courses, pass clear of each other.

The only cases to which it does apply are, when each of the two vessels is end on, or nearly end on, to the other; in other words, to cases in which, by day, each vessel sees the masts of the other **in a line,** or **nearly** in a line, with her own; and by night, to cases in which each vessel is in such a position as to **see** both the **side** lights of the other.

It does not apply, by day, to cases in which a vessel sees another ahead crossing her own course; or by night to cases where the red light of one vessel is opposed to the red light of the other, or where the green light of one vessel is opposed to the green light of the other, or where a red light without a green light, or a green light without a red light, is seen ahead, or where both green and red lights are seen anywhere but ahead.

Steam Vessels Crossing.

ART. **19**.—When two steam vessels are crossing, so as to involve risk of collision, the vessel which has the other on her own **starboard** side shall keep out of the way of the other.

Steam and Sailing Ships.

ART. **20**.—When a steam vessel and a sailing-vessel are proceeding in such directions as to involve risk of collision, the **steam** vessel shall keep out of the way of the sailing-vessel.

Risk of Collision.

ART. **21**.—Where by any of these rules one of two vessels is to keep out of the way, the **other** shall **keep** her course and speed.

Note.—When, in consequence of thick weather or other causes, such vessel finds herself so close that collision **cannot** be avoided by the action of the giving-way vessel alone, she also **shall** take such action as will best aid to avert collision. (See Articles 27 and 29.)

Avoid Crossing Ahead.

ART. **22**.—Every vessel which is directed by these Rules to keep out of the way of another vessel shall, if the circumstances of the case admit, avoid crossing ahead of the other.

Slacken Speed or Stop.

ART. **23**.—Every steam vessel which is directed by these Rules to keep out of the way of another vessel shall, on approaching her, if necessary, **slacken** her speed or **stop** or **reverse.**

Overtaking Vessel.

Art. **24**.—Notwithstanding anything contained in these Rules, **every** vessel, **overtaking** any other, shall keep out of the way of the overtaken vessel.

Every vessel coming up with another vessel from any direction more than two points abaft her beam, *i.e.*, in such a position, with reference to the vessel which she is overtaking that at night she would be unable to see either of that vessel's side lights, shall be deemed to be an overtaking vessel; and no subsequent alteration of the bearing between the two vessels shall make the overtaking vessel a crossing vessel within the meaning of these Rules, or relieve her of the duty of keeping clear of the overtaken vessel until she is **finally** past and clear.

As by day the overtaking vessel cannot always know with certainty whether she is forward of or abaft this direction from the other vessel, she should, if in doubt, **assume** that she is an overtaking vessel and keep out of the way.

In Narrow Channels.

Art. **25**.*—In narrow channels every **steam** vessel shall, when it is safe and practicable, keep to the side of the fairway or mid-channel which lies on the **starboard** side of such vessel.

Avoid Fishing Boats, &c.

Art. **26**.—Sailing-vessels under way shall **keep** out of the way of sailing-vessels or boats **fishing** with nets, or lines, or trawls. This Rule shall not give to any vessel or boat engaged in fishing the right of **obstructing** a fairway used by vessels other than fishing vessels or boats.

Special Circumstances.

Art. **27**.—In obeying and construing these Rules, due regard shall be had to all dangers of navigation and collision, and to any special circumstances which may render a departure from the above Rules necessary in order to **avoid** immediate danger.

Sound Signals for Vessels in Sight of One Another.

Art. **28**.—The words "short blast" used in this Article shall mean a blast of about **one** second's duration.

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* By a decision in the Admiralty Court, it has been held that any vessel under way must keep clear of vessels fishing, whether steam or sail.

When vessels are in **sight** of one another, a **steam** vessel under way, in taking any course authorised or required by these Rules, **shall** indicate that course by the following signals on her whistle or siren, viz. :—

One short blast to mean, "I am directing my course to **starboard.**"

Two short blasts to mean, "I am directing my course to **port.**"

Three short blasts to mean, "My engines are going **full speed** astern."

No Vessel under any Circumstances to neglect proper Precautions.

Art. **29.**—Nothing in these Rules shall exonerate any vessel, or the owner, or master, or crew thereof, from the consequences of any neglect to carry lights or signals, or of any neglect to keep a proper look-out, or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.

Reservation of Rules for Harbours and Inland Navigation.

Art. **30.**—Nothing in these Rules shall interfere with the operation of a special rule, duly made by local authority, relative to the navigation of any harbour, river or inland water.

Distress Signals.

Art. **31.**—When a vessel is in distress and requires assistance from other vessels or from the shore, the following shall be the signals to be used or displayed by her, either together or separately, viz. :—

In the daytime—

1. A gun or other explosive signal fired at intervals of about a minute;
2. The International Code signal of distress indicated by N.C.
3* The distant signal, consisting of a square flag, having either above or below it a ball or anything resembling a ball;

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* A cone point up with a ball above or below is also a signal of distress.

4. A continuous sounding with any fog signal apparatus.

At night—

1. A gun or other explosive signal fired at intervals of about a minute;
2. Flames on the vessel (as from a burning tar barrel, oil-barrel, &c.);
3. Rockets or shells, throwing stars of any colour or description, fired one at a time, at short intervals.
4. A continuous sounding with any fog-signal apparatus.

RULE OF THE ROAD FOR STEAM SHIPS.

AID TO MEMORY, BY THOMAS GRAY.

Two Steam Ships meeting.

When all three Lights I see ahead,
I port my helm and show my RED.

Two Steam Ships passing clear.

GREEN to GREEN—or RED to RED—
Perfect safety—Go ahead!

Two Steam Ships crossing.

Note.—This is the position of greatest danger; there is nothing for it but a good look-out, caution and judgment.

If to my Starboard RED appear,
It is my duty to keep clear;
To act as judgment says is proper:—
To Port—or Starboard—Back—or Stop her!

But when upon *my* Port is seen
A Steamer's Starboard Light of GREEN,
There's naught for me to do but see
That GREEN to Port keeps clear of me.

Both in safety and in doubt
I always keep a good look-out!
In danger, with no room to turn,
I ease her!—Stop her!—Go astern!

SIGNALS FOR PILOTS.

The following signals, when used or displayed together or separately, shall be deemed to be signals for a pilot:

In the Daytime :—

(1.)—To be hoisted at the fore, the Union Jack, having round it a white border one-fifth the breadth of the flag.

(2.)—The International Code Pilotage Signal, indicated by P.T.

(3.)—The International Code Flag S., with or without Code Pennant over it.

(4.)—The distant signal consisting of a cone, point upwards, having above it two balls, or shapes resembling balls.

At Night :—

(1.)—The Pyrotechnic Light, commonly known as a blue light, every fifteen minutes,

(2.)—A Bright White Light, flashed or shown at short or frequent intervals, just above the bulwarks for about a minute at a time.

LIGHTVESSELS.

In addition to her usual lights, a *white* light is exhibted from the *fore-stay* of a lightvessel, at a height of 6 *feet* above the rail, for the purpose of showing in which direction the vessel is riding, when at her station.

If from any cause the lightvessel be unable to exhibit her usual lights whilst at her station, the *riding light* only will be shown.

At lightvessels where a *hand-horn* is used during fog, the intervals will be shortened as vessels approach; and should a vessel come dangerously close, the sound will be *continuous* until she has passed.

LIGHTVESSELS OUT OF POSITION.

When a lightvessel is driven from her proper position, the usual lights will not be exhibited, but a fixed red light will be exhibited at each end of the vessel, and a red flare shown each quarter of an hour.

By Day.—The balls or other distinguishing mast-head marks will be struck.

VESSELS MARKING WRECKS.

Wreck-marking vessels have their top-sides coloured green with WRECK painted in white letters, and exhibit—

By Day.—Three balls on a yard 20 feet above the sea,—*two vertically* being on the side vessels should pass, and one on the other side.

By Night.—Three white *fixed* lights will be shown, *two vertically* on the passing side and one on the other.
These vessels will not show the ordinary riding light.

Fog Signals.—*Bell* and *Gong* in quick succession at intervals of not more than *one* minute.

WRECK BUOYS.

Buoys marking the position of wrecks are painted *green* with WRECK in white letters.

TELEGRAPH BUOYS.

Buoys marking the position of telegraph cables are painted green with TELEGRAPH in white letters.

NOTICE TO MARINERS.

The following 18 pages are taken from the "*Notices to Mariners*" which is published by the Board of Trade, and to be had free of charge from any Shipping Office in the United Kingdom.

This book contains 24 pages of general notices and all the latest changes regarding—lights, beacons, buoys and charts, also special warnings regarding dangers on various coasts, also provision depôts erected and stored for shipwrecked crews, and the distinguishing signals displayed by the vessels escorting Submarines in different parts of the World.

All Candidates for Board of Trade certificates should procure this book at the earliest opportunity.

INCORRECT CHARTS.

The Board of Trade desire to direct the special attention of Shipowners and their Servants and Agents to the necessity of seeing that the Charts taken or sent on Board of their ships are corrected down to the time of sailing. Neglect to supply a Ship with proper Charts will be brought prominently before Court of Inquiry in the event of a wreck occurring from that cause.

OIL ON ROUGH SEAS.

The Board of Trade desire to call attention to the following information, which has been published by the Admiralty in their sailing Directions, on the Use of Oil for Modifying the Effect of Breaking Waves.

" Many experiences of late years have shown the utility of oil for this purpose is undoubted, and the application simple.

" The following may serve for the guidance of Seamen, whose attention is called to the fact that a very small quantity of oil, skilfully applied, may prevent much damage both to ships (especially to smaller classes) and to boats, by modifying the action of breaking seas.

" The principle facts as to the use of oil are as follows :—

" 1. On free waves, *i.e.*, waves in deep water, the effect is greatest.

" 2. In a surf, or wave breaking on a bar, where a mass of liquid is in actual motion in shallow water, the effect of the oil is uncertain ; as nothing can prevent the larger waves from breaking under such circumstances ; but even here it is of some service.

" 3. The heaviest and thickest oils are most effectual. Refined kerosene is of little use ; crude petroleum is servicable when nothing else is obtainable ; but all animal and vegetable oils, such as waste oil from the engines, have great effect.

" 4. A small quantity of oil suffices, if applied in such a manner as to spread to windward.

" 5. It is useful in a ship or boat, both when running, or lying to, or in wearing.

" 6. No experiences are related of its use when hoisting a boat up in a seaway at sea, but it is highly probable that much time and injury to the boat would be saved by its application on such occasions.

"At anchor, when the sea is sufficient to render it difficult to hoist up or take in boats, oil bags from forward or from the swinging booms have been found to render the sea alongside comparatively smooth.

"7. In cold water, the oil being thickened by the lower temperature, and not being able to spread freely, will have its effect much reduced. This will vary with the description of oil used.

"8. The best method of application in a ship at sea appears to be :—Hanging over the side, in such a manner as to be in the water, small canvas bags, capable of holding from one to two gallons of oil, such bags being pricked with a sail needle to facilitate the leakage of the oil.

"The position of these bags should vary with the circumstances. Running before the wind they should be hung on either bow—*e.g.*, from the cathead—and allowed to tow in the water.

"With the wind on the quarter the effect seems to be less than in any other position, as the oil goes astern while the waves come up on the quarter.

"Lying-to, the weather bow and another position farther aft seem the best places from which to hang the bags, with a sufficient length of line to permit them to draw to windward, while the ship drifts.

"9. Crossing a bar with a flood tide, oil poured overboard and allowed to float in ahead of the boat, which would follow with a bag towing astern, would appear to be the best plan. As before remarked, under these circumstances the effect cannot be much trusted.

"On a bar with the ebb tide it would seem to be useless to try oil for the purpose of entering.

"10. For boarding a wreck, it is recommended to pour oil overboard to windward of her before going alongside. The effect in this case must greatly depend upon the set of the current, and the circumstances of the depth of water.

"11. For a boat riding in bad weather from a sea anchor, it is recommended to fasten a bag to an endless line rove through a block on the sea anchor, by which means the oil is diffused well ahead of the boat, and the bag can be readily hauled on board for refilling if necessary.

"12. Towing a vessel in a heavy sea, oil is of the greatest service, and may prevent parting the hawser. Distribute from the towing vessel forward and on both sides; if used only aft the tow alone gets the benefit."

BUOYS AND BEACONS.

Wrecks have occurred through undue reliance on buoys and floating beacons always being maintained in their exact position.

They should be regarded simply as aids to navigation.

The lights shown by gas buoys cannot be implicitly relied on, as, if occulting, the apparatus may get out of order.

A ship should always when possible be navigated by bearings or angles of fixed objects on shore.

FOG SIGNALS.

Sound is conveyed in a very capricious way through the atmosphere. Apart from wind, large areas of silence have been found in different directions and different distances from the signals, in some instances even when in close proximity to the sound signal.

The Mariner should not assume:—

1. That he is out of ordinary hearing distance, because he fails to hear the sound.
2. That because he hears a fog signal faintly, that he is a great distance from it.
3. That he is near it, because he hears the sound plainly.
4. That the distance from and the intensity of the sound on any one occasion, is a guide to him for any future occasion.
5. That the fog signal has ceased sounding, because he does not hear it even when in close proximity.

DERELICT VESSELS (REPORT) ACT, 1896.

1. Every Master or other person for the time being in command of any British ship, after the passing of this Act, who shall become aware of the existence on the high seas of any floating derelict vessel, shall notify the same to the Lloyd's Agent at his next place of call or arrival, and shall, together with such notification, furnish to the Lloyd's Agent all such information as he may possess as to the supposed locality or

identity of such derelict vessel, and the date when and place where the same may have been observed by or reported to him, and the Lloyd's Agent shall forthwith, on receipt of such notification and information, transmit the same to the Secretary of Lloyd's in London.

And if any such master fails to make such a report he shall be liable on summary conviction, to a penalty not exceeding five pounds.

COMPASSES—HEELING ERROR.

The attention of Mariners is hereby directed to the necessity of exercising a constant watchfulness in regard to the errors of their navigating compasses, more particularly to the heeling error, the neglect of which is doubtless a common, though often unsuspected, cause of the stranding of many vessels.

Serious changes frequently take place in the character and amount of the heeling error as the ship changes her magnetic latitude; from (1) the vertical force arising from the permanent magnetism of the ship, the error from which is greatest in high latitudes, diminishes until the Equator is reached, where it is least, and increases again in the opposite hemisphere, but still retaining the same name; (2) from vertical induction in vertical soft iron, and transverse soft iron generally (such as beams, &c.), the error from which is greatest in high latitudes, diminishes until the Equator is reached, where it becomes nil, and increases again (but of an opposite name) as the vessel recedes from the Equator in the opposite hemisphere. It is difficult therefore to predict with any great accuracy the change that will take place, observations at every possible opportunity being the only reliable safeguard.

In the Northern hemisphere in ships built with their heads from about S.E., through N., to S.W. (the usual effect of the permanent magnetism of the ship then conspiring with that of her vertical and transverse soft iron), the N point of the compass needle, assuming the compass to be on the upper deck and on the after portion of the ship as usual, will as a general rule be drawn to windward or to the high side of the ship, the nearer the ship's head was to N whilst building, the greater the error that may be expected; the effect being to throw the ship to windward of her supposed position when steering on Northerly courses, and to leeward on Southerly courses, the error decreasing as the Equator is approached, and small, perhaps of a contrary name, in the Southern hemisphere.

In ships built with their heads from about SE, through S, to SW (the usual effect of the permanent magnetism, and that of the transverse, &c., soft iron then being contrary to each other), the N end of the compass needle may be drawn to leeward depending upon whether the vertical force of the permanent magnetism or that of the induced magnetism of transverse and vertical soft iron predominates, but the error would then as a general rule be small in Northern latitudes and large in the Southern hemisphere.

It has been established as a rule, however, that in the Northern hemisphere (in compasses above the upper deck) in the majority of iron ships the N point of the compass needle is drawn to windward or the high side of the ship, the consequence being that if this is not allowed for, a ship will go to windward of her supposed position on Northerly courses, and to leeward on Southerly courses.

The heeling error is always greatest with the ship's head at or near N to S by the disturbed compass, and least, or nil, with the ship's head E or W. It is particulary important, therefore, should the vessel heel over either from the effect of the wind, or the cargo when steering in a Northerly or Southerly direction that the Mariner should use every precaution and never lose an opportunity of ascertaining the errors of his compass.

The heeling error may be small or large, depending greatly upon the position of the compass—it has been known to exceed 2° for every degree of heel of the ship—and is directly proportional to the amount of heel, consequently if the error at N or S, for 1° of heel is known, the error for any other direction of the ship's head, and amount of heel, can be found by the usual methods.

Mariners are further warned that the adjustment of compasses by magnets, soft iron, &c., which is for bringing the error within manageable limits and for equalising the directive force of the needle, must only be considered approximate for the lat. in which the adjustment was made, and that they should lose no opportunity of verifying the error both in port and at sea, as it is usually constantly changing from numerous causes, the chief amongst which are heeling, change of lat., change of cargo, collision, after repairs, and from the ship remaining with her head in one direction for a length of time, &c.

COMPASSES—LOCAL ATTRACTION.

Mariners are warned that in some parts of the world there are depths of water sufficient for the largest ships to navigate in safety, where the bottom is sufficiently magnetic and close enough to affect their compasses, and increased vigilance should be used when approaching these countries at night or in thick weather. The following are places known to be so affected:—Loch Spelve and Loch Buy, Scotland, W. Lough Larne, Ireland.

Shetland Isles. North Quarken, Gulf of Bothnia. Iceland and its adjacent waters. Odessa Bay, and the shoal south of it. Isle de Los, W. Coast of Africa, Coasts of Madagascar, especially near St. Mary's Isle. Tumboro Volcano, Sumbawa Island, near Java. Cossack; North Australia. New Ireland Bougainville, Solomon Islands. Grand Manan Island, Fundy Bay, Cape St. Francis, Labrador, Other parts of the globe are suspected of similar disturbing effects, and all those experiencing it should on the spot determine its locality, and report about it as they would any other hidden danger.

CONCISE RULES FOR REVOLVING STORMS.

1. Revolving storms are so named because the wind in these storms revolves round an area of low pressure situated in the centre. They have also local names, and are termed Hurricanes in the West Indies and South Pacific Ocean; Cyclones in the Indian Ocean, Bay of Bengal, and Arabian Sea , and Typhoons in the China Sea.

2. In these storms the wind always revolves the same way in the same part of the world ; that is, against the movement of the hands of a watch in the Northern hemisphere, and with the hands of a watch in the Southern hemisphere. The wind does not revolve in circles, but has a spiral movement, inwards towards the centre.

3. Revolving storms have also, as a general rule, a progressive movement. Within the tropics they usually move from east to west at first, and then curve towards the pole of the hemisphere in which the storm is generated, and afterwards move from west to east.

4. The track which the centre of the storm takes is called the path of the storm, and the portion of the storm-field on the right of the path is known as the right-hand semicircle, and that on the left as the left-hand semicircle.

5. In the right-hand semicircle, if the observer be stationary, the wind will always shift to the right, and in the

left-hand semicircle to the left. This law holds good in both hemispheres.

6. If a vessel be so situated in a storm that by running before the wind the path of the advancing storm will be crossed, this is considered to be the dangerous semicircle. This will always be the right-hand semicircle in the Northern hemisphere, and the left hand in the Southern.

7. These storms are most frequent in the Northern hemisphere from July to November, and in the Southern hemisphere from December to May. In the Bay of Bengal and Arabian Sea they, however, occur most frequently about the time of the monsoon.

8. The area over which revolving storms have been known to extend varies in diameter from 20 miles to some hundreds of miles, and their rate of movement in the West Indies averages about 300 miles a day; in the China Sea, Bay of Bengal and Arabian Sea about 200 miles a day; and in the Indian Ocean from 0 to 200 miles a day, the more stationary storms occurring at the beginning and end of the Hurricane season.

9. The indications of the approach of a revolving storm are:—(1) An unsteady barometer, or even a cessation in the diurnal range which is constant in settled weather; (2) a heavy swell not caused by the wind then blowing; (3) an ugly, threatening appearance of the sky.

10. In order to judge what is the best way to act if there is reason to believe a storm is approaching, the seaman requires to know (*a*) in which direction the centre of the storm is situated; (*b*) in which semicircle the ship is situated.

11. As these points cannot be determined if a vessel is moving with any speed through the water, the first proceeding should be to "stop" or "heave to," and, as it is always best to assume, at first, that the vessel may be in the dangerous semicircle, she should be hove to on the starboard tack in the Northern hemisphere and on the port tack in the Southern.

12. If an observer faces the wind the centre of the storm will be from 12 to 8 points on his right hand in the Northern hemisphere and on his left hand in the Southern hemisphere; 12 points when the storm begins; about 10 points when the barometer has fallen $\frac{3}{10}$ of an inch, and about 8 points when it has fallen $\frac{6}{10}$ of an inch or upwards.

13. If the wind shifts to the right the vessel is in the

right-hand semicircle, if to the left in the left-hand semicircle, and if the wind is steady in direction but increasing in force, she is in the direct path of the storm.

14. If the seaman has reason to think that his vessel is in the direct path of the storm he should run with the wind on the starboard quarter in the Northern and on the port quarter in the Southern hemisphere until the barometer has ceased falling. If she is in the right-hand semicircle in the Northern hemisphere she should remain hove to on the starboard tack, but if in the Southern hemisphere run with the wind on the port quarter; if she is in the left-hand semicircle in the Northern hemisphere she should run with the wind on the starboard quarter, but if in the Southern hemisphere remain hove to on the port tack.

15. Should a vessel not have sufficient room to run when in the least dangerous semicircle, she should heave to on the port tack in the Northern and on the starboard tack in the Southern hemisphere.

16. If in a harbour or at anchor the seaman should be just as careful in watching the shifting of the wind and ascertaining the direction of the centre, as by so doing he will be able to tell on which side of the path of the storm he is situated, and be able to act according to circumstances.

17. Should the centre of a storm pass over a vessel, the wind, after blowing furiously in one direction, ceases for a time, and then blows with equal fury from the opposite direction. This makes a confused pyramidal sea which is especially dangerous.

COLLISIONS WITH LIGHTVESSELS.

Caution.—In consequence of Lightvessels being from time to time run into, the Corporation of Trinity House deem it desirable to warn Mariners that when passing a Lightvessel and particularly when attempting to cross her bows, they should make due allowance for the set of the tide. Anybody wilfully or negligently running foul of any Lightvessel or buoy shall, in addition to the expense of making good any damage so occasioned, incur a penalty of fifty pounds.

TRINITY HOUSE CAUTION.

FLOATING WRECKAGE.—Considerable expense and loss of time having recently been caused in sending out Trinity House steamers to search for wreckage reported to be dangerous to navigation, which has proved to consist only of sheep and cattle pens, and other temporary deck fittings for live stock; Masters of vessels are hereby cautioned against throwing over bulky wooden structures and other useless lumber, which may at a distance appear to be dangerous to navigation.

CAUTION WHEN APPROACHING BRITISH PORTS.

PART I.—CLOSING OF PORTS.—(1) The Lords Commissioners of the Admiralty, having taken into consideration the fact that local or other circumstances may arise in which it may be necessary, on account of periodical exercises, manœuvres, or otherwise, to forbid all entrance to certain ports of the Empire, this is to give Notice that on approaching the shores of the United Kingdom, or any of the ports or localities of the British Empire, a sharp look-out should be kept for the signals described in the following paragraph (2), and for the vessels mentioned in paragraph (5), Part II., of this Notice, and the distinguishing and other signals made by them. In the event of such signals being displayed, the port or locality should be approached with great caution, as it may be apprehended that obstruction may exist

(2) If entrance to a port is prohibited, 3 Red vertical Lights by night, or 3 *Red vertical Balls by day, will be exhibited in some conspicuous position, in or near to its approach, which signals will also be shown by the vessels indicated in paragraph (5), Part II., of this Notice. If these signals are displayed, vessels must either proceed to the position marked "Examination Anchorage" on the Admiralty charts and anchor there, or keep the sea.*

Part II.—EXAMINATION SERVICE.—(4) Under certain circumstances it may become necessary to take special measures to examine vessels. (5) In such case, vessels carrying the distinguishing flags or Lights mentioned in paragraph (7) will be charged with the duty of examining ships which desire to enter the ports and of allotting positions in which they shall anchor. (6) As the institution of the Examination Service at any port will never be publicly advertised, especial care should be taken in approaching the ports, by day or night, to keep a sharp look-out for any vessel carrying the flags or Lights mentioned in paragraph (7), and to be ready to "bring to" at once when hailed by her or warned by the firing of a gun or sound rocket. (7) *By day* the distinguishing flags of the Examining Steamer will be a special flag (*white* and *red* horizontal surrounded by a *blue* border) and a *blue* ensign. Also, 3 *red* vertical balls if the port is closed. *By night* the steamer will carry—(*a*) 3 *red* vertical Lights if the port is closed. (*b*) 3 *white* vertical Lights if the port is open. The above lights will be carried in addition to the ordinary navigation Lights, and will show an unbroken light around the horizon. (8) Masters are warned that, before attempting to enter any of these ports when the Examination Service is in force, they must in their own interest strictly obey all instructions given to them by the Examining Steamer. In the absence of any instructions from the Examining Steamer they must proceed to the position marked "Examination Anchorage" on the Admiralty Charts and anchor there, or keep to sea.

Signals to be made by Vessels approaching Defended Ports when Inconvenienced by Searchlights.

Any vessel approaching a defended port in the United Kingdom or any of the British Dominions and also on the coast of France, and the French colonies, when searchlights are being worked, and finding that they interfere with her safe navigation, may make use of the following signals, either singly or combined:—(*a*) by Flash lamp, 4 *short* Flashes followed by 1 *long* Flash. (*b*) whistle, siren, or fog-horn, 4 *short* blasts followed by 1 *long* blast. Whenever possible, both Flash lamp signals and sound signals should be used. On these signals being made, the searchlights will be worked so as to cause the least inconvenience, being either doused, raised, or their direction altered.

SUBMARINE VESSELS.

Caution.—Notice is hereby given that Submarine Vessels are being constantly exercised off the coasts of the United Kingdom; also in the vicinity of Gibraltar, Malta and Hongkong. In order to minimise the risk of collision with other vessels, the vessel escorting the Submarine will when the latter are exercising, display a large *red* flag at the mast-head. Every vessel seeing this signal should steer so as to give the escorting vessel a berth of at least 1 mile, and also to pass astern of her; when from any cause this cannot be done, the escorting vessel should be approached at a slow speed until warning is given by flags, semaphore or megaphone, as most convenient, of the danger zone, a good look out being kept meanwhile for the Submarines, whose presence may be only indicated by their periscopes showing above water.

The following are the distinguishing signals displayed by the parent or escorting vessels for the various nations:—

One *red* flag:—United Kingdom, Norway and Italy.
Two *red* flags vertical:—Germany, Denmark and Japan.
France—Square flag with 1 *yellow* and 1 *red* horizontal stripe. At night—2 *red* lights over 1 *white* light.
Russia—Pennant "V" of the Russian Military code, (red, white and blue) under a *red* ball at the masthead.

PROVISION DEPÔTS.

The following are the *Provision Depôts* erected and stored for shipwrecked crews in uninhabited parts of the World.

South Indian Ocean—Amsterdam, St. Paul and Kerguelan Islands; also Hog and Possession Islands (Crozet Islands).
New Zealand—Three Kings, Middleton Reef and Kermadec Islands, (North of New Zealand.)
Snares, Bounty, Antipodes, Auckland and Campbell Islands. (South of New Zealand.)
Tasmania—Rocky Point.
Vancouver—Cape Beale and Carmanah Lighthouse.
Iceland—Ingolfs Hofde Huk, Refuge hut with bread, sugar, coffee, &c.

SINGLE SHIPS APPROACHING SQUADRONS.

The Board of Trade find it necessary to warn Mariners that it would be in the interest of safety for single ships to adopt timely measures to keep out of the way of and avoid passing through a squadron.

CAUTION.—STEERING ORDERS USED BY CERTAIN FOREIGN PILOTS.

Certain Foreign Governments having adopted helm or Steering Orders bearing meanings directly opposite to the sense in which they are used on British ships, Masters and Officers of British ships are reminded that Foreign Pilots are not authorised to give that rudder command on board British ships, but are bound to indicate to the officer in charge the direction in which they desire the vessel's head to be put, so that the officer in charge may issue his own command to the steersman.

COMMUNICATIONS WITH LLOYD'S SIGNAL STATIONS BY MORSE.

Lloyd's Signal Stations.—At the following stations arrangements have been made to take in any messages made by a Flash Lamp with the Morse Code:—Dover, Horse Sand Fort (Spithead), St. Catherine's Point, Prawle Point, Lizard, Inishtrahull, Old Head of Kinsale, Brow Head, Fasnet Rock Lighthouse. Similar arrangements of a temporary and experimental character are in force at Dungeness, Beachy Head, Barry Island, and Dunnet Head. Lloyd's Signal Stations at Gibraltar and Perim have also been equipped for Morse Signal by Flash Lamp. *July, 1912.**

SPECIAL NOTICE—WIRELESS TELEGRAPHY.— TRANSMISSION OF REPORTS IN REGARD TO DERELICTS AND WEATHER CONDITIONS.

1. *Derelicts.*—Whenever a derelict is observed lying in the track of ships, and dangerous to navigation, its position should be notified by wireless telegraphy to the nearest British Coast Station. Upon receipt of the information steps will immediately be taken to notify the Admiralty, Lloyd's and the Meteorological Office, and to forward the particulars by wireless telegraphy to ships proceeding on the N. Atlantic, S. Atlantic and North Sea Routes, as the case may be, for a period of 4 days, after the receipt of the information. No Shore Station or inland charge will be made for this service.

2. *Weather Reports.*—Reports in regard to the local weather conditions prevailing at the Post Office Wireless Coast Stations can be obtained by sending a radio-tel. to the nearest Wireless Station. The Shore Station charge for the radio-tel. and its reply will be 5s.

3. *Meteorological Reports.*—Information as to (1) the state of the weather in various parts of the Eastern Atlantic, the United Kingdom and the Continent (2) weather forecasts for any part of the British Coasts or ice in the Atlantic can be obtained by wireless telegraphy. The Shore Station and Meteorological Charge for the radio-tel. and its reply will be 5s. 6d., in addition to the cost of the inland telegram.

In order to furnish the information in the most convenient form the reply message will—if no special particulars are required—be sent as in the following examples :—

(1) S.W. 7, b, c, q, Sea 5, fog 0.
(2) Calm, b, sea 0, fog 1.

This would indicate :—

(1) "S.W. wind strength 7, Blue sky, detached clouds, squally, Rough Sea, no fog or mist.
(2) Calm, blue sky, sea calm, mist.

The abbreviations denoting the state of the weather and force of the wind will be as follows :—

STATE OF THE WEATHER.

b Blue Sky
c Cloud (detached)
d Drizzling rain
e Wet air without rain
f Fog
g Gloom
h Hail
l Lightning
m Mist
o Overcast sky
p Passing Showers
q Squalls
r Rain
s Snow
t Thunder
u Ugly (threatening sky)
v Visibility, objects at a distance usually visible
w Dew
z Haze

Note.—A figure preceding a letter shows how many hours that style of weather had prevailed since last observation, thus, 4 r means four hours rain, 2½ l means two and a half hours vivid lightning, &c., &c.

SCALE OF INTENSITY.

Scale.	Name.	On Sea.	On River.
0	No fog or mist.	Hor. clear.	
1	Light og or mist.	Hor. invisible, but Lights & landmarks generally visible at working dists.	Objects indistinct but nav. unimpeded.
2, 3	Moderate fog	Lts., passing vessels, and landmarks generally indistinct under a mile. Fog sigs. are sounded.	Navigation impeded, additional caution required.
4, 5	Thick fog ...	Ship's Lts. and vessels invisible at ¼ mile or less.	Navigation suspended.

SEA DISTURBANCE SCALE.

Scale.	Description.	Height of waves in ft. from crest to rough.	Condition of Surface.	Scale.	Description.	Height of waves in ft. from crest to trough.	Condition of Surface.
0	Calm.	—	Glassy	5, 6	Rough to very rough.	5 to 10 ft.	Much disturbed; deeply furrowed
1, 2	Smooth	—	Rippled	7, 8	High to very high.	11 to 15 ft. 15 to 35 ft.	Rollers with steep fronts.
3, 4	Slight to Moderate.	Under 5 ft.	Rocks buoy or small boat. Furrowed	9, 10	Phenomenal.	36 ft. and above.	Precipitious; towering.

WIND FORCE.

Figures to denote force of wind.	Description wind.	Mode of estimating on board sailing ships.	Equivalent velocity of wind in miles per hour.
0	Calm	—	0
1	Light air ...	Sufficient wind for working ships.	2
2	Light breeze ...		5
3	Gentle breeze ...		10
4	Moderate breeze	Forces most advantageous for sailing with leading wind and all sail drawing.	15
5	Fresh breeze ...		21
6	Strong breeze ...	Reduction of sail necessary with leading wind.	27
7	Moderate gale..		35
8	Fresh gale ..	Considerable reduction of sail necessary even with wind quartering.	42
9	Strong gale ...		50
10	Whole gale ...	Close reefed sail running or hove to under storm sail.	59
11	Storm		68
12	Hurricane ...	No sail can stand even running.	above 75

WIRELESS WEATHER REPORTS FROM EIFFEL TOWER (PARIS).

The Bureau Central Météorologique of France despatches for the benefit of Eastward bound ships in the North Atlantic a meteorological message by radio-tel. from the Eiffel Tower, each day, immediately after the time signal at 11 a.m. from the following six stations:—Reykjavik, Valencia, Ouessant (Ushant), Corunna, Horta, for 7 a.m., and for St. Pierre (Miquelon) for the proceeding 8 a.m.

The coded part of the message is given in seven groups. The initial group—BCM, for Bureau Central Météorologique indicates the source from which the information emanates.

The above-named stations are desigated by the letters R. V. O. C. H. S. respectively. The two figures in each group following the prefix letter of the station indicate the barometrical pressure in millimetres (the first figure 7 being omitted). The next two figures indicate the wind direction (points), the fifth its force, on the scale ranging from 0 = calm, to 9 = hurricane, and the sixth, the state of the sea from 0 = calm to 9 = tremendous. The groups referring to Reykjavik and St. Pierre (Miquelon) contain five figures only, because reports relating to sea disturbances at these stations are not available.

When any of the above details have to be omitted in the message the omission is signified by the figure 9.

Specimen of Despatch—5th July, 1911.

BCM R 48167 V 742013 O 753211 C 680411 H 739901 S 62162 anticyclone Europe Centrale beau temps general depression ouest Islande allant vers est.

Interpretation of Message.

Letter.	Station.	Barometer.		Wind.				Sea.
				Direction.		Force.		
R	Reykjavik	48	748	16	S	7	9	—
V	Valencia ...	74	774	20	SW	1	1	3
O	Ouessant (Ushant)	75	775	32	N	1	1	1
C	Corunna	68	768	04	NE	1	1	1
H	Horta	73	773	99	—	0	0	1
S	St. Pierre	62	762	16	S	2	3	—

SALVAGE OF TORPEDOES.

INSTRUCTIONS FOR THE RECOVERY AND SAFE HANDLING OF TORPEDOES LOST FROM H.M. SHIPS.

1. A torpedo is a cigar shaped object, varying from 15 to 22 ft. long, and from 14 to 21 ins. in diam. It has a more or less pointed nose and tapering tail. At the after end of the tail are fins, rudders and 2 screw propellers, one immediately abaft the other. It is generally made entirely of steel. The weight of torpedoes varies from under half a ton to a ton and a quarter.

2. **A TORPEDO USED IN PEACE EXERCISES NEVER CONTAINS ANY EXPLOSIVE MATERIAL.**

A Calcium Light is used in the nose to assist in recovery; it is quite harmless and may be left to burn out.

3. A person who does not understand the mechanism of a torpedo should be careful to avoid touching any small levers which project from a slit in the upper part of the torpedo a little abaft the middle of the body of the torpedo. It is possible, under certain conditions, that the screw propellers of a derelict torpedo may be caused to revolve rapidly if these levers are moved. Fingers, hands and body should be kept clear of the propellers at all times in case they should be accidently started, when a nasty cut may result.

4. A torpedo may be found floating, sometimes lying flat along the surface of the water, and sometimes with its tail submerged and its nose only showing above the water.

5. It should be taken in tow by means of a wire or stout rope (at least 3 ins.) with a running eye (or noose) in the end.

6. If the tail of the torpedo can be reached, the running eye should be passed over the screw propellers and fins, and bowsed taut around the small part of the tail.

7. If the tail is submerged, the running eye should be dropped over the nose and allowed to fall down until it grips the small part of the tail in the same way.

8. The torpedo should then be towed tail first.

9. Should it be desired to hoist a torpedo in-board it should be slung with a good wire strop around the centre of the torpedo; the balancing point is about in line with those projections on each side which are rather less than half way from nose to tail. Before hoisting, lines should be made fast to the tail and nose and these lines should be attended so as to keep the torpedo level while hoisting, and preventing it slipping through the strop. When the torpedo is inboard, it should be lashed down to the deck, or on wooden chocks to keep it off the deck, and the screw propellers should be well lashed together to prevent any chance of their starting to revolve.

10. A torpedo when recovered, should be handed over to the most convenient Coastguard or Naval Authority, with a statement of where it was found, and any details of importance.

11. A reward of at least £5 is offered for a lost torpedo after it has been missing for a day.

12. In case of damage to gear or loss of any kind incurred in the recovery of a torpedo, a written statement should be handed over with the torpedo, and any reasonable increase in the reward will then be considered by the Admiralty.

PILOTS.

Pilots.—*Caution.*—In view of the danger and difficulty often attending the shipping and discharging of Pilots in exposed positions, the Master or Officer in charge of the bridge should take care to satisfy himself, on dropping the Pilot, that the latter is well clear of the ship and particularly of the counter before the propeller is moved.

RADIO-TELEGRAPHIC PRACTICE BETWEEN H.M. SHIPS OF WAR AND BRITISH MERCHANT VESSELS.

The Board of Trade have been requested by the Lords Commissioners of the Admiralty to direct the attention of Masters and Owners of British Merchant vessels to the necessity for arranging for periodical practices in wireless telegraph communication between H.M, Ships of War and Ships of the British Mercantile Marine for the purpose of ensuring efficient and reliable communication when required.

It is therefore hoped that all British Shipowners and Masters whose ships are fitted with Wireless Telegraph will co-operate to give effect to the following proposals :—It is pointed out that the exercise must always be subject to the exigencies of H.M. Service, and these practices should only be carried out when they will not interfere with commercial or naval work. 1.—At 8-30 a.m. and 2-30 p.m. daily any single man-of-war (destroyers and small craft excluded) or one man-of-war in a fleet in company, detailed by the Senior Naval Officer present, will adjust her Wireless Telegraph transmitting and receiving apparatus to the commercial 600 metre wave length and make the call "CCCC," followed by her own commercial call sign, indicating that she is prepared to carry out an exercise with any British merchant ship within range.

BRITISH ISLANDS.

Sweeping Operations.—*Caution.*—H.M. Vessels are frequently engaged in sweeping operations off ports in the United Kingdom. Whilst so engaged, they work in pairs, connected by a wire hawser, and are consequently hampered to a very considerable extent in their manœuvring powers. With a view to indicate the nature of the work on which these vessels are engaged, they will show the following signals :—A *black* ball at the foremast head and a similar ball at the yardarm, or where it can best be seen, on that side on which it is dangerous for vessels to pass.

IMPORTANT NOTICE.—ADMIRALTY PUBLICATIONS.

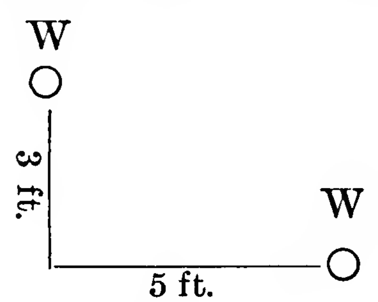
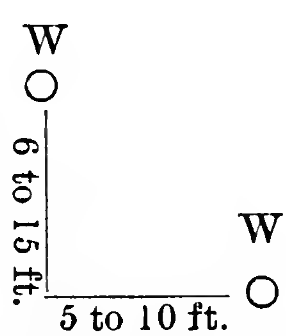
True bearings being introduced.—Notice is hereby given that True bearings are being introduced as soon as practicable in all Admiralty publications. Details of the new system are as follows :—(*a*) On Charts.—A new pattern compass is being gradually introduced which enables True Bearings to be laid off on the chart in addition to Magnetic Bearings. (See "Reed's Plan and Chart Work.")

SYNOPSIS of LIGHTS to be CARRIED and SHOWN by all STEAM and SAILING VESSELS, TRAWLERS, FISHING BOATS, &c.

Mast Head Lights must be at least 20 *feet and need not be more than* 40 *feet above the Deck, Side Lights must show from right ahead to 2 points abaft the Beam.*

		Distance visible. Miles.
Steam Ships Under Way.	White Mast Head Light, Green and Red Side Lights. A Steam Ship may also carry an additional Mast Head Light.	5 2 5
Steam Vessels less than 40 tons.	White Mast Head Light 9 ft. above gunwale, also Side Lights.	2 1
Vessels under Oars or Sails, less than 20 tons.	(1) Shall have ready at hand a Lantern with Red and Green glass, or (2) a Lantern showing a White Light.	
Steam Ships Towing.	**Two** White Mast Head Lights vertical (at least 6 ft. apart) and Green and Red Side Lights. If towing more than one vessel and the length of tow exceed 600 ft., an additional White Light will have to be carried. A White Light abaft the funnel may also be carried.	5 2 5
Steam Ships and Sailing Ships not under Command.	*At Night*—Two Red Lights Vertical—6 ft. apart ● Red ● Red *By Day*—Two Black Balls or Shapes Vertical—6 ft. apart, at least 2 ft. in diameter, and when making way at night, in addition Red and Green side lights.	2

		Visible Miles.
Steam Ships and Ships Laying Telegraph Cables.	*At Night*—Three Lights—Red, White, and Red. Vertical—6 ft. apart ● Red ○ White ● Red *By Day*—Red Ball, White Diamond Shape, Red Ball, not less than 6 ft. apart—thus ● Red <>White ● Red and when *making way* at night, in addition, Red and Green Side Lights.	2
Flare-up for any Vessel.	Every Vessel may show a flare-up, or use any detonating signal to attract attention.	
Sailing Ships under way or any Vessel being Towed.	Red and Green Side Lights.	2
Small Vessels in Bad Weather.	Side Lights, lit and ready for use, to be exhibited in sufficient time to prevent collision.	
Steam Ships and other Vessels at Anchor. (under 150 ft.)	White Light, visible all round the Horizon, and not to exceed 20 ft. above the hull.	1
150 ft. or over.	Two White Lights, the forward one not less than 20 and not more than 40 ft. above the hull, the one near the stern not less than 15 ft. below the forward Light.	1
Vessel Aground in a Fairway.	Lights for a Vessel at anchor, also Lights for a Ship not under command.	1 2
Sailing Pilot Vessels.	White Mast Head Light, and Flare-up at intervals of at least every 15 minutes also Side Lights at short intervals when nearing other vessels. A Sailing Pilot obliged to go alongside another vessel, may show the White Light instead of carrying it at the Mast Head, and have a lantern ready at hand with a red and green glass.	

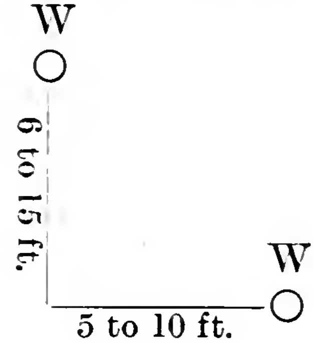
		Visible Miles.
STEAM PILOT VESSELS (UNDER WAY).	White Mast Head Light, and Red Light below it thus—8 ft. apart. ○ White ● Red also Side Lights and White Flare.	2
STEAM PILOT VESSELS (AT ANCHOR).	White Mast Head Light and Red Light 8 ft. below, both visible all round the horizon. ● White ○ Red also Flare up.	2
PILOT VESSELS NOT ON PILOTAGE DUTY.	Same as other ships.	
OPEN BOATS FISHING WITH TACKLE NOT MORE THAN 150 FEET AWAY.	One White Light visible all round the horizon	
OPEN BOATS FISHING WITH TACKLE MORE THAN 150 FEET AWAY.	One all round White Light, and when approached by another vessel will show a second White Light 3 feet below the first and 5 feet towards the tackle. 	
VESSELS DRIFT NET OR LINE FISHING.	Two Bright White Lights (visible all round the Horizon) where best seen. Lower Light in the direction of nets. 	3 3

Visible Miles.

Boats with Lines. Same as drifting.

Drift Net or Line Fishing on the Coasts of Japan, Korea & Mediterranean, less than 20 tons.

Carry the Upper Light and show the Lower on the approach of other vessels.



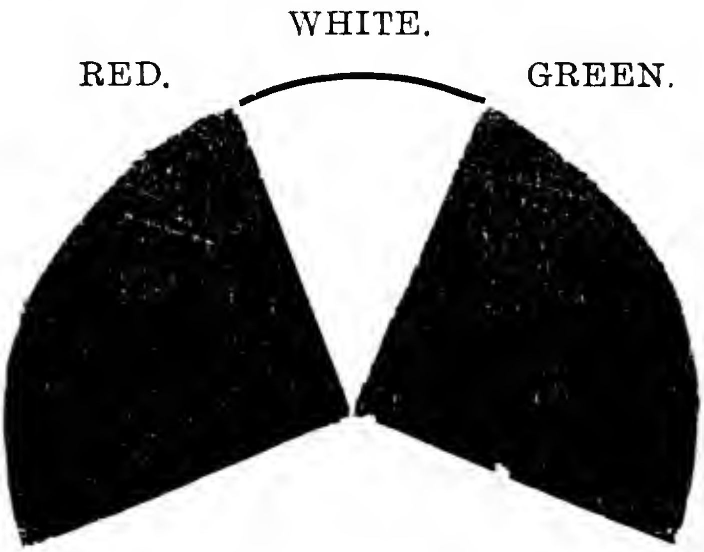
Visible miles: 3 (upper W); 1 (lower W)

Vessels Fishing with Towing Lines or Shooting Lines.

Same lights as other vessels under way according to whether they are steam or sail.

Steam Vessels Trawling.

A tricoloured lantern at mast head with Red, White and Green Lights visible 2 miles.
White showing ahead over 4 points, Red and Green showing 8 points each, and underneath the tricoloured lantern not less than 6 nor more than 12 ft. a White Light visible all round the horizon 2 miles.



2

Red and Green Lights to show 2 points abaft the beam.

		Visible Miles.
SAILING VESSELS TRAWLING.	Carry a White Light, visible all round the horizon 2 miles, and show on the approach of other vessels a White Flare or Torch.	2
VESSELS FISHING WITH DREDGE-NETS. OYSTER DREDGERS.	Carry and show the same lights as Trawlers.	2
FLARE-UP AND WORKING LIGHTS.	All Fishing Vessels may use a Flare-up at any time to attract attention. They are also allowed to use Working Lights.	
FISHING BOATS. STATIONARY.	Fast to Rocks &c.—Same as ships at anchor. They shall also haul down the day signal, and in Fog, Mist, &c., make the signal for a vessel at anchor.	1
FISHING BOATS AT ANCHOR.	Same as other ships at anchor according to their length.	1
FISHING VESSELS AT ANCHOR WITH THEIR GEAR OUT.	Same as other vessels at anchor, according to length, and on the approach of other vessels show another White Light 3 feet below the Anchor Light and 5 feet towards the gear.	1
FISHING VESSELS DURING DAYTIME.	Display a Basket or some other efficient signal, and if fishing when at anchor shall, on the approach of other vessels, show the Basket on the side those other vessels can pass.	
FISHING BOATS AND TRAWLERS IN FOG, &c.	In Fog or Snow showers (attached to their Nets, &c.) shall use a Fog Horn or Siren and ring a Bell alternately every minute.	
DITTO UNDER 20 TONS.	Same as above, or some other efficient sound signal every minute.	

		Visible Miles.
Steam Ships and Sailing Ships Overtaking One Another	The one ahead to show from her stern a White Light (may be fixed) or Flare up.	1
Steam Ship under Sail only, with Funnel up	One Black Ball, forward, 2 feet in diameter.	
Steam Ships in thick Weather.	Slacken Speed. Go easy. Blow Whistle or Siren at least every 2 minutes, and be provided with a Fog Horn and Bell. *Day and Night*—Ring Bell rapidly every minute when at anchor.	
Steam Ships stopped under Way in thick Weather.	Two prolonged blasts every 2 minutes.	
Sailing Ship in thick Weather.	Use Fog Horn (1, 2, or 3 Blasts) to indicate what she is doing. *Day and Night*—Ring bell rapidly every minute when at anchor.	
Vessel towing or being towed, Vessel Laying or Picking up Telegraph Cable, or Vessel not under Command in thick Weather.	**Three** Blasts, one prolonged and two short, at intervals of not more than **two** minutes.	
Vessels Marking Wrecked Ships.	Hull painted green (Wreck in White Letters). *Night Time*— 2 Bright White Lights vertical on passing side. 1 Bright White Light on other side. *Day Time*—2 Balls vertical on passing side. 1 Ball on other side. *In Fog*—Ring the Bell and Sound Gong alternately every minute.	

LIGHT VESSELS OUT OF POSITION AND NO GOOD FOR NAVIGATION.	*Night Time*—1 Red Light forward. 1 Red Light Aft. Red Flare every **15** minutes. *Day Time* — Balls and Distinguishing Marks *Struck*.
EXAMINATION SERVICE IN FORCE AT NAVAL PORTS. (EXAMINING STEAMER.)	*Night Time*—(*a*) **3** Red Lights vertical when the port is closed. (*b*) **3** White Lights vertical when the port is open. Also the navigation lights. *Day Time* — Special Flag (White and Red horizontal surrounded by Blue border) and a Blue Ensign. Also **3** Red Balls vertical when the port is closed.
WRECK BUOY.	Painted *Green*, with WRECK in White letters.
TELEGRAPH BUOY.	Painted *Green*, with TELEGRAPH in White letters.

EXAMINATION IN THE REGULATIONS FOR PREVENTING COLLISIONS AT SEA.

All Applicants for examination, whether for Certificates as Masters or Mates, are to be examined as to their knowledge of the Regulations each time they present themselves for examination.

Questions suggested by the following heads of examination are to be asked in addition to, and are not to supersede, any other questions proper and necessary to be asked by the Examiner.

The following questions need not be adhered to literally by the Examiner, and are not all to be asked; but the substance of the leading questions should be asked, and all that are asked should be satisfactorily answered, before an Applicant is reported to have passed his examination. The Examiner should make such a selection of the questions as each case appears to him to require.

Q. Where and by what vessels are the Rules to be followed? See preliminary (p. 38).

Q. When is a steam vessel considered a sailing vessel, and when a steam vessel? See preliminary (p. 38).

Q. What does the word "steam vessel" in the Rules include?

Ans. The word "steam vessel" as used in the Rules includes any vessel propelled by machinery.

Q. When is a vessel to be considered under way by these Rules?

Ans. When she is not at anchor, or made fast to the shore, or aground.

Q. What does the word "visible" in the Rules, when applied to lights, mean?

Ans. Visible on a dark night with a clear atmosphere.

Q. During what time must the Rules concerning lights be complied with? See Art. 1.

Q. What light or lights are required by the Regulations to be exhibited by sailing vessels at anchor?

See Art. 11.

Q. What light or lights are required by the Regulations to be exhibited by steam vessels at anchor ?

Ans. The same as by sailing vessels.

Q. Where is the anchor light to be exhibited in a vessel under 150 feet in length ? See Art. 11.

Q. Where must the two anchor lights be shown in vessels of 150 feet and upwards ? See Art. 11.

Q. In what direction or directions must the anchor lights show ?

Ans. They must show a clear, uniform, and unbroken light, visible all round the horizon.

Q. At what distance must they be visible ?

Ans. At least one mile.

Q. What shall be deemed to be the length of a vessel ?

Ans. The length appearing in the certificate of registry.

Q. What light or lights must a vessel aground in or near a fairway carry ? See Art. 11.

Q. What is the number of lights required by the regulations to be carried by sailing vessels when under way at night ? See Arts. 5 and 10.

Q. Of what colour are these lights, and how are they to be placed on board the ship ? See Art. 2 (*b* and *c*).

Q. What description of light must be shown from the sides of sailing vessels under way ; and over how many points of the compass, and in what directions, and how far, are they required to show ? See Arts. 5 & 2 (*b* & *c*).

Q. What lights are they to carry when being towed at night ? Ans. The same.

Q. Are the side lights required to be fitted with screens ; and if so, of what length, and how ?

See Art. 2 (*d*).

Q. What is the number of lights required by the regulations to be carried by steam vessels when under way at night ? See Arts. 2 and 10.

Q. Of what colour are these lights, and how are they to be placed on board the ship ? See Art. 2.

Q Over how many points of the compass, in what direction, and how far, is the foremast-head light of a steam vessel required to show ? See Art. 2. (*a*).

Q. Are the side lights required to be fitted with screens ; and if so, of what length ? See Art. 2 (*d*).

Q. Over how many points of the compass, in what directions, and how far are the coloured side lights of steam vessels required to show ? See Art. 2 (*b* and *c*.)

Q. May a steam vessel when under way carry any additional light or lights ? See Art. 2 (*e*).

Q. What description of lights are steam vessels required to carry when they are not under steam, but under sail only ? Ans. Side lights only, the same as sailing vessels.

Q. What exceptional lights may small vessels carry ? See Art. 6.

Q. Are steam vessels of less than 40 tons gross tonnage compelled to carry the same lights as other steam vessels ; if not, what lights may they carry instead ?
See Art. 7 (*a* and *b*).

Q. Are small steamboats, such as are carried by seagoing vessels, obliged to carry the white light 9 feet above the gunwale ?

Ans. No ; but it must be carried above the combined lantern.

Q. What lights may vessels under oars or sails of less than 20 tons gross tonnage carry ? See Art. 7 (3).

Q. What light must rowing boats, whether under oars or sails, carry ? See Art. 7 (4).

Q. What description of lights are pilot vessels required to carry when on their stations on pilotage duty ?
See Art. 8.

Q. What lights may pilot vessels which are obliged to go alongside of a vessel to put a pilot on board, carry ?
See Art. 8.

Q. What description of lights are steam pilot vessels required to carry when on their stations on pilotage duty, and not at anchor ?

See Art. 8.

Q. What description of lights are steam pilot vessels required to carry when on their stations on pilotage duty in British waters, and at anchor ? See Art. 8.

Q. What description of lights are pilot vessels required to carry when not on their station on pilotage duty ?
See Art. 8.

Q. What lights are open boats and fishing vessels of less than 20 tons net register required to carry when under way and not actually engaged in fishing ?
See Arts. 9 and 7 (3).

Q. What lights are fishing vessels and fishing boats of 20 tons net register, or upwards, required to carry when under way and not actually engaged in fishing ?
See Arts. 9, 2 and 5.

Q. What light is an open boat, whilst actually engaged in fishing with outlying tackle not more than 150 feet into the seaway, required to carry ? See Art. 9 (*a*), first part.

Q. What lights are open boats, whilst actually engaged in fishing with outlying tackle extending more than 150 feet into the seaway, required to carry and show ?
See Art. 9 (*a*), second part.

Q. What lights are vessels, whilst actually engaged in drift net fishing, required to carry ?
See Art. 9 (*b*), first part.

Q. What lights are vessels of less than 20 tons, whilst actually engaged in drift net fishing on the coasts of Japan, Korea and Mediterranean Sea, required to carry and show ? See Art. 9 (*b*), second part.

Q. What lights are vessels whilst actually engaged in line fishing, required to carry ? See Art. 9 (*c*) first part.

Q. What lights are vessels of less than 20 tons, whilst actually engaged in line fishing on the coasts of Korea, Japan and Mediterranean Sea, required to carry and show ?
See Art. 9 (*c*), second part.

Q. What lights are steam trawlers of any tonnage, whilst actually engaged in trawling or dragging an apparatus along the bottom of the sea, required to carry ?
See Art. 9 (*d*), 1.

Q. What lights are sailing trawlers of any tonnage whilst actually engaged in trawling or dragging an apparatus along the bottom of the sea, required to carry, and show ? See Art. 9 (*d*), 2.

Q. What lights are oyster dredgers, and other vessels, fishing with dredge-nets, required to carry and show ?
See Art. 9 (*e*).

Q. May fishing vessels and fishing boats use any other lights in addition to the compulsory lights ?
See Art. 9 (*f*).

Q. What light is a fishing vessel or a fishing boat under 150 feet in length to exhibit when at anchor ?
See Art. 9 (*g*), first part.

Q. What lights are fishing vessels of 150 feet in length or upwards required to exhibit when at anchor ?
See Art. 9 (*g*), second part.

Q. What lights are fishing vessels, when at anchor and attached to a net or other fishing gear, required to carry and show ? See Art. 9 (*g*), third part.

Q. If a vessel, when fishing, becomes stationery in consequence of her gear getting fast to a rock or other obstruction, what light or lights must she show and what signal must she make ? See Art. 9 (*h*).

Q. What sound signals are fishing vessels of 20 tons and upwards, also of less than 20 tons, required to make whilst engaged in fishing in thick weather ?
See Art. 9 (*i*).

Q. What signal must be displayed during the daytime by vessels fishing to indicate their occupation ? (*a*) When not at anchor. (*b*) When at anchor. See Art. 9 (*k*).

Q. Are vessels actually engaged in fishing required to carry the lights prescribed by Article 4 (*a*) and the last paragraph of Article 11 ? No.

Q. What lights are steam vessels required to carry when towing other vessels ? See Art. 3.

Q. May a vessel towing carry any other light ?
See Art. 3 (last par.)

Q. What light is a vessel which is being overtaken by another required to show ? See Art. 10.

Q. May the white light be fixed ?
See Art. 10 (last par.)

Q. Describe the lights and the day signals that vessels employed in laying and picking up a telegraph cable are required to carry. See Art. 4 (*b*).

Q. Describe the lights and the day signals that vessels which from any cause are not under command are required to carry. See Art. 4 (*a*).

Q. Are the above-mentioned vessels to carry side lights ? See Art. 4 (*c*).

Q. What are the shapes and lights carried by telegraph ships and ships not under command intended to indicate to approaching vessels ? See Art. 4 (*d*).

Q. Do these rules prevent squadrons and convoys from carrying special lights, or vessels exhibiting recognition signals ? See Art. 13.

Q. May vessels exhibit any other lights in order to attract attention ? See Art. 12.

Q. What signals must a steam vessel proceeding under sail only, but having her funnel up, carry in the daytime ?
See Art. 14.

Q. What sound signals are steam vessels and sailing vessels of 20 tons gross tonnage or upward required by the regulations to be provided with ? See Art. 15.

Q. When are these signals to be used ?
Ans. In fog, mist, falling snow, or heavy rain storms, whether by day or night.

Q. What does a prolonged blast mean ?
Ans. A blast from 4 to 6 seconds duration.

Q. On what are the fog signals to be made by steam vessels under way ? Ans. On the whistle or siren.

Q. On what are the fog signals to be made by sailing vessels and vessels towed ? Ans. On the fog horn.

Q. What sound signal is to be made by vessels at anchor ? See Art. 15 (*d*).

Q. What sound signal is required to be made by a steam vessel having way upon her? See Art. 15 (*a*)

Q. What sound signal is required to be made by a steam vessel under way, but stopped, and having no way upon her? See Art. 15 (*b*).

Q. What sound signals are required to be made by sailing vessels when under way? See Art. 15 (*c*).

Q. What sound signals are required to be made by a vessel when towing, a vessel employed in laying or in picking up a telegraph cable, or a vessel under way which is unable to get out of the way of an approaching vessel through not being under command or unable to manœuvre as required by the Rules? See Art. 15 (*e*).

Q. What sound signal may a vessel being towed make? See Art. 15 (*e*).

Q. What sound signal must sailing vessels and boats of less than 20 tons gross tonnage make? See Art. 15 (*e*).

Q. Do the regulations require vessels to take any other precautions during thick weather? See Art. 16.

Q. What action must be taken by a steam vessel hearing apparently forward of the beam the fog signal of another vessel the position of which is not ascertained? See Art. 16.

Q. How can you generally ascertain whether there is risk of collision in approaching another vessel? See preliminary to Art. 17.

Q. When a steam vessel under way takes any course required by these Rules, must she indicate that course to any vessel she has in sight? Yes. See Art. 28.

Q. What does the expression "short blast" used in the preceding question mean?

Ans. It means a blast of about one second's duration.

Q. What precaution is to be taken by steam vessels which are directed by these Rules to keep out of the way when approaching another vessel?

Ans. They shall, if necessary, slacken speed, or stop and reverse.

Q. If you see two white lights in a vertical line one over the other, what do they denote as regards the vessel carrying them ?

Ans. They may denote the presence of a steam vessel end on with her side lights not within sight on account of distance, fog, &c., or a steam vessel towing with her side lights not within sight on account of distance, fog, &c. ; or a vessel end on to me engaged in drift net fishing, or in line fishing ; or it may be a steam trawler end on or within two points of being end on, to me, or a vessel of 150 feet or upwards in length at anchor and end on to me.

Q. If you see a green, or a red, light with a white light below, what do they denote ?

Ans. They denote the presence of a steam vessel engaged in trawling.

Q. If you see a white light alone, what does it denote as regards the ship carrying it ?

Ans. It denotes the presence of a vessel or boat at anchor ; or a pilot vessel on her station ; or the mast-head light of a vessel, under steam, with her side lights not within sight on account of distance, fog, &c. ; or a fishing vessel stationery through her gear getting fast to some obstruction, or an open boat fishing, or a sailing trawler engaged in trawling ; or it may be a light shewn from the stern of a vessel which is being overtaken.

Q. If you see a green or a red light without a white light, or both a green and a red light without a white light, is the vessel carrying the light or lights seen a vessel under steam or a vessel under sail ?

Ans. A vessel under sail.

Q. How do you know ?

Ans. Because there is no mast-head light.

Q. If you see a white light over a coloured light, is the vessel a vessel under sail or a vessel under steam ?

Ans. A vessel under steam. The mast-head light denotes that the vessel is under steam.

[The Examiner will then take one model of a vessel, which he will place on the table and call A. He will then take the mast or stand with a white and a red ball on it, and place it at the other end of the table, and call it B.

The Examiner should be careful that the model of one vessel only is used when the questions on page 90 are asked.]

Q. A is a steam vessel going north, seeing a white light and a red light right ahead at B. Are A and the vessel B showing the two lights meeting end on, or nearly end on, or is B passing A, or is B crossing the path of A, and in what direction, and how do you know?

Ans. Passing to port, because if I see a red light ahead I know that the head of the vessel carrying that red light must be pointing away in some direction to my own port or left hand. The vessel showing the red light has her port or left side more or less open to A.

Q. If A is going north, within what points of the compass must the vessel B showing the white and red lights be steering?

Ans. B must be going from a little W of S to WNW.

Q. How do you know this?

Ans. Because, the screens being properly fitted, I could not see the red light of B at all with the vessel's head in any other direction.

Q. A is a steam vessel going north, and seeing a white and green light ahead. Are A and B meeting, or is B passing A, or is B crossing the course of A, and in what direction; and how do you know?

Ans. B is passing to starboard of A, because if I see a green light ahead I know that the head of the vessel carrying that green light must be pointing away in some direction to my starboard or right hand. The ship showing the green light has her right or starboard side more or less open to me.

Q. As A is going north, within what points of the compass must the vessel showing the white and green lights be steering?

Ans. B must be going from a little E of S to ENE.

Q. How do you know?

Ans. Because, the screens being properly fitted, I cannot see the green light at all with the vessel's head in any other direction. (See Rule page 95.)

Q. If a steam vessel A see the *three* or *four* lights of another steam vessel B ahead or nearly ahead, are the two steam vessels meeting, passing, or crossing ?

Ans. Meeting end on, or nearly end on.

Q. Do the regulations expressly require the course of a vessel to be altered to starboard in any case ; and, if so. when ?

Ans. Yes ; in the case of two steam vessels meeting end on, or nearly end on.

Q. Do they expressly require the course of a vessel to be altered to starboard in any other case ; and, if so, in what other ?

Ans. No. It is not in any other case expressly required by the regulations.

[The Examiner should see that the Candidate places the models in the positions indicated by the following questions.]

Q. If a steam vessel A sees another steam vessel's red light B on her own starboard side, are the steam vessels meeting, passing, or crossing, and how do you know ?

Ans. Crossing, because the red light of one is opposed to the green light of the other.

Q. Is A to stand on ; and, if not, why not ?

Ans. A must keep out of the way. (Art. 19.)

Q. Is A to starboard or to port in such a case ?

Ans. A must do what is right so as to get herself out of the way of B, and must, if the circumstances of the case permit, avoid crossing ahead of B.

Q. If A gets into collision by porting, will it be because she is acting on any rule ?

Ans. No ; the rule does not require her to either port or to starboard. If she ports and gets into collision by porting, it is not the fault of any rule.

Q. If a steam vessel A sees the green light of another steam vessel B on her own (A's own) port bow, are the two steam vessels meeting, passing, or crossing ; and how do you know ?

Ans. Crossing, because the green light of one vessel is shown to the red light of the other.

Q. What is A to do, and why?
See Art. 21 and 27.

Q. A, a steam vessel, sees the green light of another steam vessel, B, a point on her, A's, port bow. Is there any regulation requiring A to port in such a case, and if so, where is it to be found?

Ans. There is not any.

Q. Are steam vessels to get out of the way of sailing vessels?

Ans. Yes, (Art. 20), unless the sailing vessel is overtaking the steam vessel.

Q. What is to be done by A, whether a steam vessel or a sailing vessel, is overtaking B.

Ans. A is to keep out of the way of B.

Q. When is a vessel considered to be an overtaking vessel? See Art. 24.

Q. In the day time how do you know when you are an overtaking vessel? See Art. 24 (last par.)

Q. Have sailing vessels under way to keep out of the way of sailing vessels and boats fishing? See Art. 26.

Q. When by the rules one of two ships is required to keep out of the way of the other, what is the other to do?

Ans. To keep her course, and speed.

Q. Is there any qualification or exception to this?

Ans. Yes. (Art. 27.)

Q. Is there any general direction in the steering and sailing rules; and, if so, what is it?

Ans. Yes. Art. 29.

Q. Can you repeat article (——) of the regulations? I refer to the article containing the rule for (——).

[The Examiner will repeat this question, naming a different article every time.]

Q. Is there any special rule for steam vessels navigating narrow channels? Ans. Yes. Art. 25.

Q. Do the Regulations for preventing collisions at sea apply to sea-going vessels in harbours and in rivers?

Ans. Yes; unless there is any rule to the contrary made by a competent authority.

Q. What would be a serious offence ?

Ans. To cause a collision by porting the helm or doing anything not required by the regulations and without due consideration.

Q, How do you distinguish a wreck marking vessel ?

Ans. A vessel marking a wreck is painted green with WRECK in white letters, and has a yard with at night two white lights vertical, on one yard arm (passing side) and one white light on the other yard arm (wreck side)

BY DAY.—Two balls vertical on passing side and one ball on wreck side.

FOG SIGNAL.—Bell and gong in quick succession every minute.

Q. How do you distinguish a Lightvessel out of position ?

Ans. Red light at each end at night and red flares every 15 minutes.

BY DAY.—All distinguishing signals struck.

Q. How do you distinguish a wreck Buoy ?

Ans. A wreck buoy is painted *green* with WRECK in white letters.

Q. How to distinguish a Telegraph Buoy ?

Ans. A Telegraph buoy is painted *green* with TELEGRAPH in white letters.

Q. How do you distinguish the Examining Steamer off a Naval Port, when the Examination Service is in force ?

Ans. NIGHT TIME.—In addition to navigation lights, 3 red lights vertical when the port is closed, and 3 white lights vertical when the port is open.

DAY TIME—Special flag (white and red horizontal surrounded by blue border) and a blue ensign. Also 3 red balls vertical when the port is closed.

STEAMSHIPS AND SHIPS CROSSING.

Diagrams showing Three different Positions of a Light Crossing.

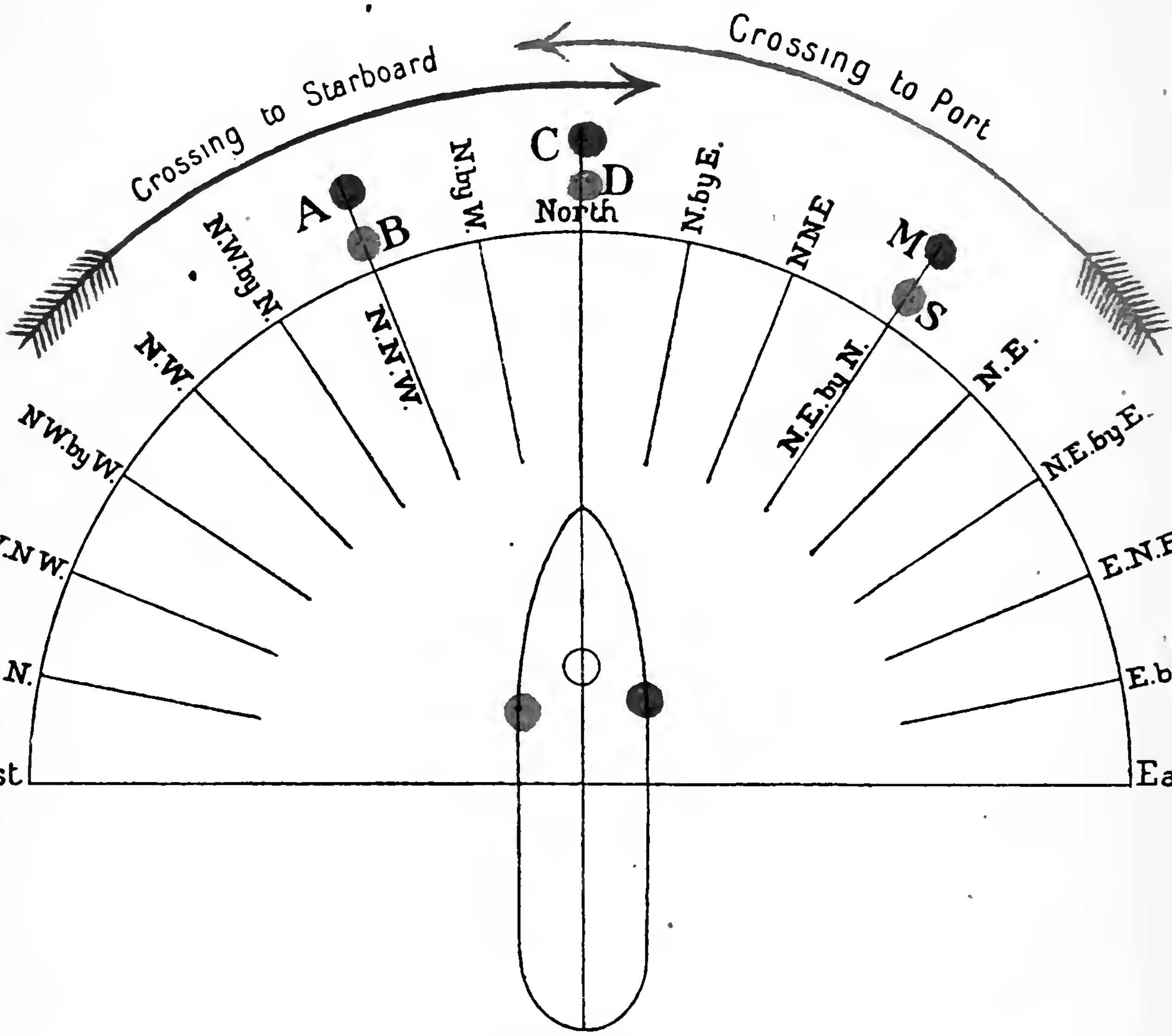


Fig. 19.

Light A.—Going to Cross. Light B.—Has Crossed.
Light C.—Is Crossing Light D.—Is Crossing.
Light M.—Has Crossed. Light S.—Going to Cross.

Allow 6 points to the *Right* of the Bearing and the opposite point to the bearing for a *Green* light and 6 points to the *Left* of the bearing and the opposite point to the bearing for a *Red* light, to ascertain the direction in which any ship can be going. (See page 95.)

RULE OF THE ROAD.

Q. You see a ship's side light, can you tell on the instant how she is going ?
Ans. Not the particular course she was steering ; but I could tell within ten points.

Q. What is the rule to find the ten points a ship is going between for you to see the light ?
Ans. Six points to the right of the bearing for a green light, and the opposite point to the bearing, and six points to the left of the bearing, and the opposite to the bearing for a red light.

Q. A steamship's red light is bearing North, how would she be steering ?
Ans. Between WNW and South nearly.

Q. NNE ?
Ans. Between NW and SSW nearly.

Q. NE ?
Ans. Between NNW and SW nearly.

Q. ENE ?
Ans. Between North and WSW nearly.

Q. A steamship's green light bears North, how would she be steering ?
Ans. Between ENE and South nearly.

Q. NNW ?
Ans. Between NE and SSE nearly.

Q. NW ?
Ans. Between NNE and SE nearly.

Q. WNW ?
Ans. Between North and ESE nearly.

Q. Why do say nearly ?
Ans. Because a ship would show both side lights when she was steering on the opposite point to the bearing.

Q. Will this rule apply to sailing ships ?
Ans. Yes, but allowance will have to be made for the wind, as a sailing ship will only lay six points from the wind when she is close hauled.

Q. Wind North, sailing ship's red light bears South, how is she steering ?
Ans. Between ESE and ENE. Six points to the left of

South is ESE, and opposite point to South is North. A sailing ship could not lay on all points between ESE and North with a northerly wind, as six points from North is ENE, hence ESE to ENE.

Q. Wind North, sailing ship's red light bears SW ?
Ans. SSE to ENE.

Q. Wind North, sailing ship's red light bears WSW ?
Ans. South to ENE. In this example she can sail on all the points and show the light.

Q. Wind North, green light bears South ?
Ans. WSW to WNW.

Q. Wind North. green light bears SE ?
Ans. SSW to WNW.

Q. Wind North, green light bears ESE ?
Ans. South to WNW. In this example she can sail on all the points and show the light.

Q. Wind South, green light bears North ?
Ans. ENE to ESE.

Q. Wind South, red light bears NE ?
Ans. NNW to WSW.

Q. Wind NW, green light bears SW ?
Ans. NNE to NE.

Q. Wind NW, green light bears South ?
Ans. WSW only.

Q. Wind NE, green light bears South ?
Ans. WSW to NNW.

Q. Wind East, green light bears South ?
Ans. WSW to North nearly.

Q. Wind NE, red light bears South ?
Ans. ESE only.

Q. Wind NW, red light bears South ?
Ans. ESE to NNE.

Q. Wind SE, red light bears South ?
Ans. ENE to North nearly.

Q. Wind SW, red light bears South ?
Ans. ESE to North nearly.

The Candidate is strongly advised not to neglect these bearings, he should also give himself other examples with the wind and bearings from different directions.

RULE OF THE ROAD.

STEAMSHIPS.

Red Light on Starboard side.

Keep clear of all red lights on starboard side (Art. 19). Fig. 20, A, B, C, D and E.

If two or three points on the bow, alter your course to starboard. Fig. 20, D.

If five or six point on the bow, take a bearing and watch how it alters; if the light is closing slowly and keeping on the same bearing, slacken speed, and let the light pass ahead; if the light is closing in and slowly drawing astern, alter your course to port and keep your speed; if the light is closing in and slowly drawing ahead, slacken speed, and let the light pass ahead. Fig. 20, B.

Green Light on Port side.

Stand on for all green lights on port side (Art. 21). The green lights have to keep clear (Art. 19); if the green light is so close that collision cannot be avoided by the action of the giving-way vessel, you will also have to take such action as will best aid to avert collision. (Note, Art. 21 also Arts. 27 and 29.) See Fig. 21, A,B,C,D and E.

End on.

All three lights ahead, each alters course to starboard, (Art. 18.) Figs. 20 and 21, K.

Three Lights on Starboard Bow.

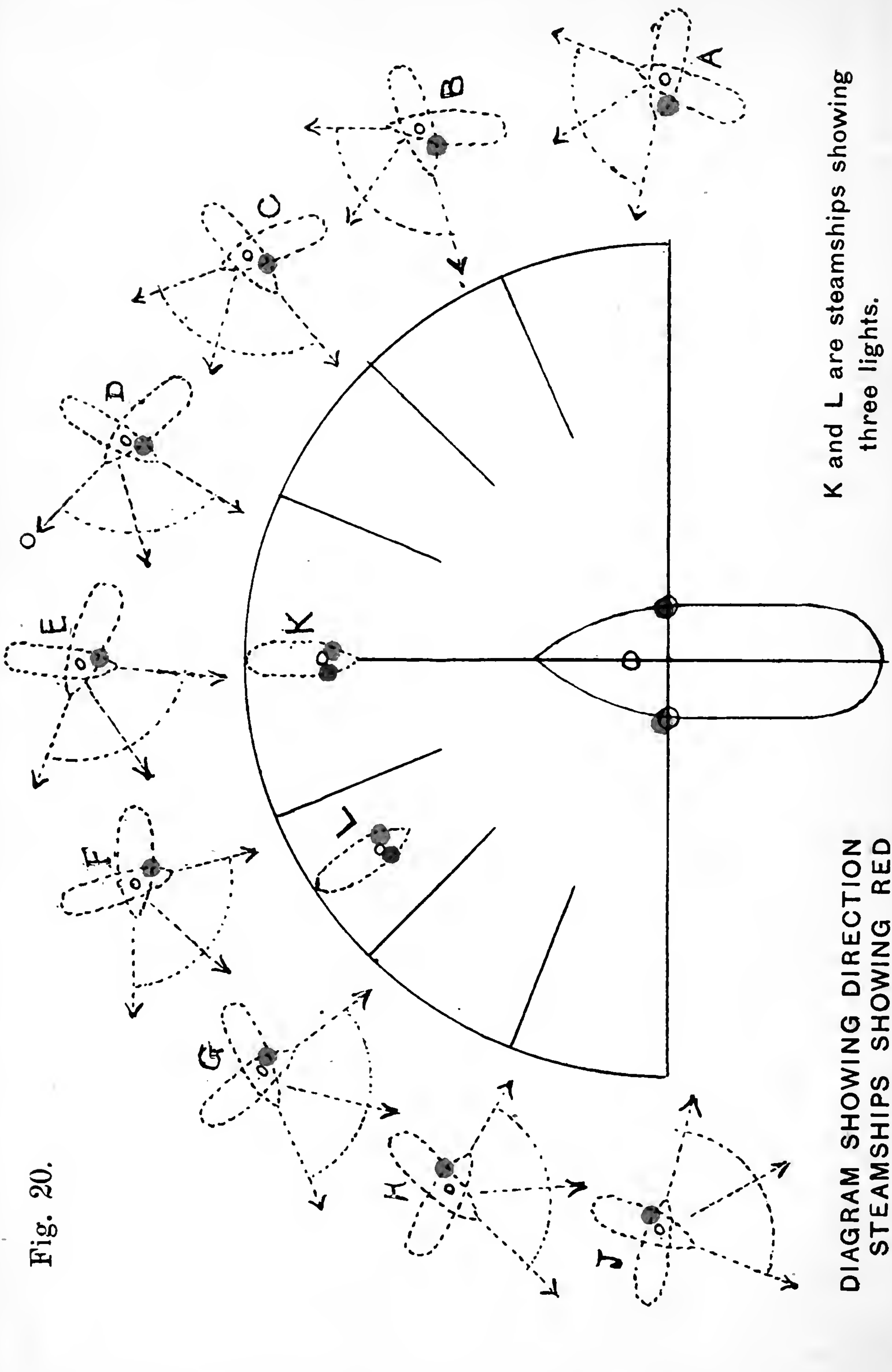
When all three lights are seen on starboard bow, keep clear (Art. 19); the ship showing the three lights stands on (Art. 21). This is not a case where both are meeting end on; see last paragraph of Art. 18. Fig. 21, L.

Three Lights on Port Bow.

When all three lights are seen on port bow, stand on (Art. 21); the ship showing the three lights keeps clear (Art. 19). This is not a case where both are meeting end on; see last paragraph of Art. 18. Fig. 20, L.

Overtaken.

When being overtaken by another ship, show a white light or flare up over the stern (Art. 10). The ship which



K and L are steamships showing three lights.

Fig. 20.

DIAGRAM SHOWING DIRECTION STEAMSHIPS SHOWING RED LIGHTS MUST BE STEERING.

is overtaking the other, whether a sailing ship or steamship keeps clear (Art. 24).

Sailing Ships and Steamships.

A steamship always keeps clear of a sailing ship, unless being overtaken by the sailing ship.

Fishing Vessels and Vessels under way.

It has been decided that all vessels when approaching vessels fishing (whether the fishing vessels be steam or sail) must keep out of the way.

SAILING SHIPS.

Free with Wind on Starboard side.

Keep clear of all green lights to leeward or ahead, and stand on for all red lights to windward.

Free with wind on Port side.

Keep clear of all red lights to leeward or ahead, and stand on for all green lights to windward, unless the green light has the wind on starboard side.

Light on Weather Bow.

An opposite coloured light on the weather bow is most likely to have the wind aft or on the quarter.

NOTE.—It is well to hold hard on to this rule, as many candidates have failed through fancying they knew a special case where the light was close hauled on the opposite tack; the position the light was placed by the examiner being a clear case of a ship running free. (See note to wind on starboard quarter, page 101.)

Close hauled on either tack.

If an opposite coloured light be less than four points on the lee bow, it will be on the opposite tack, and if more than four points on the lee bow it will be on the same tack.

Wind abeam on either side.

If an opposite coloured light be less than *two* points on the lee bow it will be close hauled on the opposite tack; if three points on the lee bow it will be in stays; if more than four points on the lee bow, it will be on the same tack.

Wind abaft the beam on either side.

All opposite coloured lights to leeward will be on the same tack.

Fig. 21.

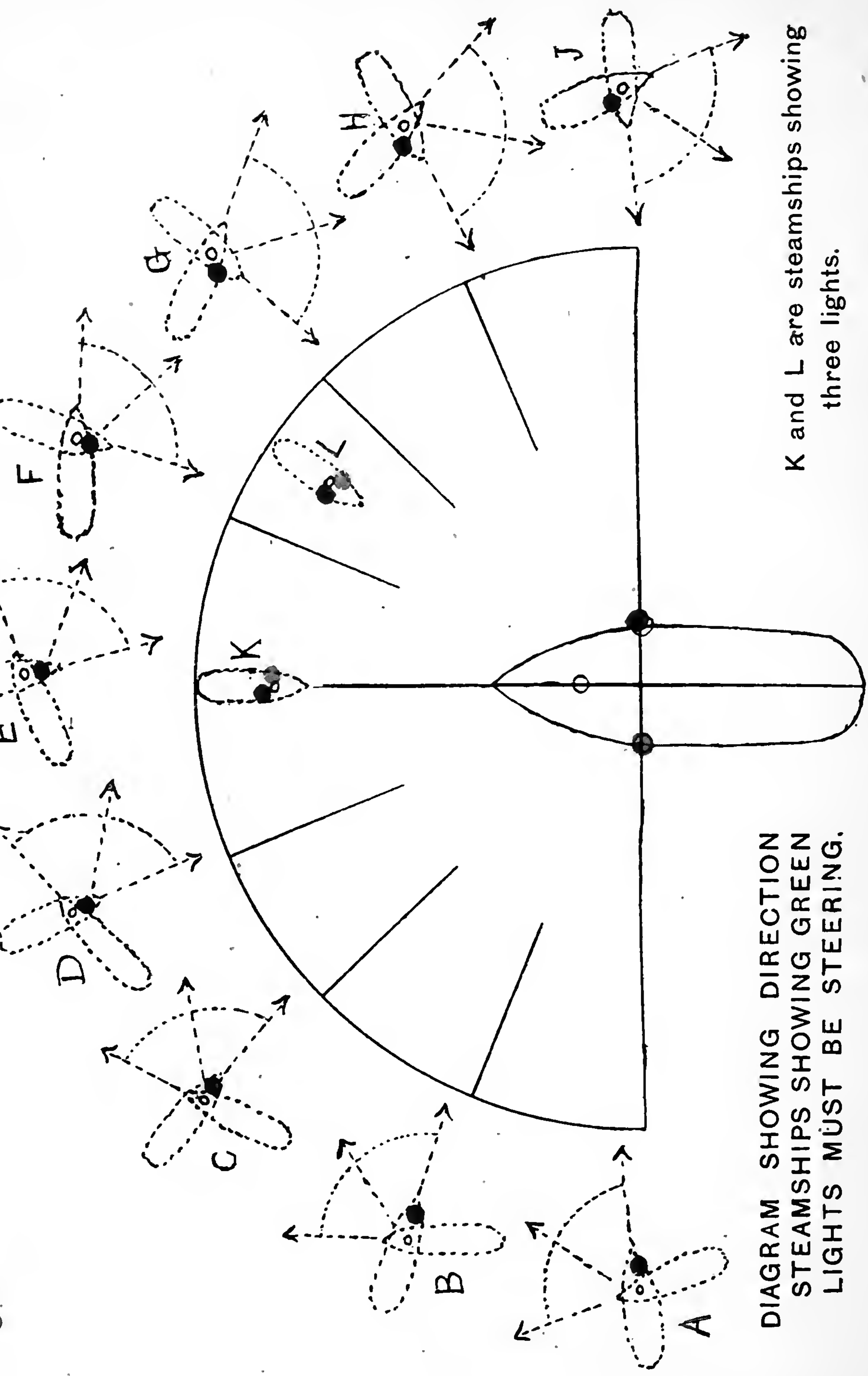


DIAGRAM SHOWING DIRECTION STEAMSHIPS SHOWING GREEN LIGHTS MUST BE STEERING.

K and L are steamships showing three lights.

WIND ABEAM STARBOARD SIDE.

Note.—The following examples refer to Art. 17.

Q. You see a red light on the starboard beam what would you do ?

Ans. Stand on ; the other ship has the wind on the same side ; and consequently is the weather ship. Fig. 22, A.

Q. Suppose the red light is four points on the weather bow ?

Ans. Stand on ; the other ship is the weather ship, with the wind on the starboard quarter, or she has got the wind aft. Fig. 22, B.

Q. Suppose the red light is a point and a half on the weather bow ?

Ans. Stand on ; the other ship has the wind aft, or on the port quarter. Fig. 22, C.

Q. You see two coloured lights on the weather bow ?

Ans. Stand on ; the other ship is free with the wind on the port side. Fig. 22, J.

Q. You see two lights coloured right ahead ?

Ans. Stand on ; the other ship is free with the wind on the port side. Fig. 22, H.

Wind on the Starboard Quarter.

Stand on for all the red lights to windward ; if the light is on the beam the other ship will be going the same way, and be the weather ship, or she will have the wind aft, Fig. 23, A. ; and if the light be on the bow, the other ship will have the wind aft, or on the port quarter, Fig. 23, B.

NOTE.—When the light is about one point on the weather bow, it might be a ship close hauled, but much more likely a ship running free with the wind on the port quarter, Fig. 23, C. This is the case alluded to on page 99. (See note.)

Close hauled on Starboard Tack.

Suppose a red light to be on the weather beam, the other ship would be going the same way or running free with the wind on the same side, Fig. 24, A ; suppose the light is four points on the weather bow, the other ship would be free and to windward, Fig. 24, B ; and suppose the light to be two points on the bow, then the other ship

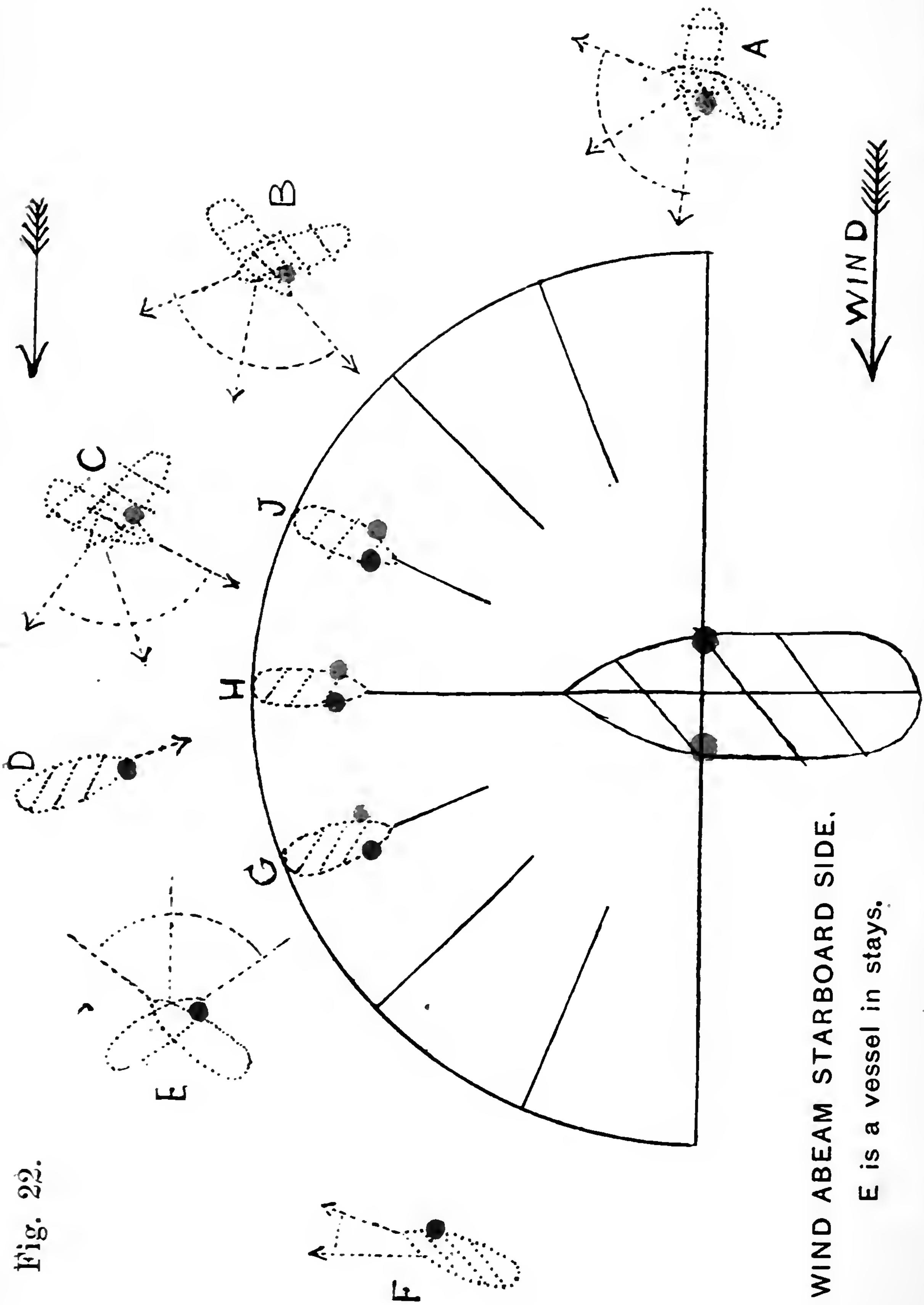


Fig. 22.

WIND ABEAM STARBOARD SIDE.

E is a vessel in stays.

would have the wind aft or on the starboard quarter, Fig. 24, C. It is clear in the three cases just mentioned you would have to stand on.

Wind on Starboard Beam (free ship).

Q. Suppose you see a green light anywhere between two points on the lee bow and ahead, what would you do ?

Ans. Keep clear ; the other ship is close hauled on the port tack. Fig. 22, D.

Q. Suppose it is three points on the lee bow ?

Ans. Keep clear, the other ship will be in stays, unless she was a ship that lay closer than six points to the wind then she might be close hauled on the starboard tack. Fig. 22, E.

Q. Suppose it is more than four points on the lee bow ?

Ans. Keep clear, the other ship is on the same tack. Fig. 22, F.

Q. You see two coloured lights two points on the lee bow ?

Ans. Keep clear, the other ship is close hauled on the port tack. Fig. 22, G.

Wind on the Starboard Quarter.

Q. You see a green light three points on the lee bow, what would you do ?

Ans. Keep clear, the other ship will have the wind about abeam of close hauled on starboard tack. Fig. 23, D.

Q. You see the light about two points before the lee beam ?

Ans. Keep clear, the other ship can have the wind anywhere on the starboard side, and consequently I will be the weather ship. Fig. 23, E.

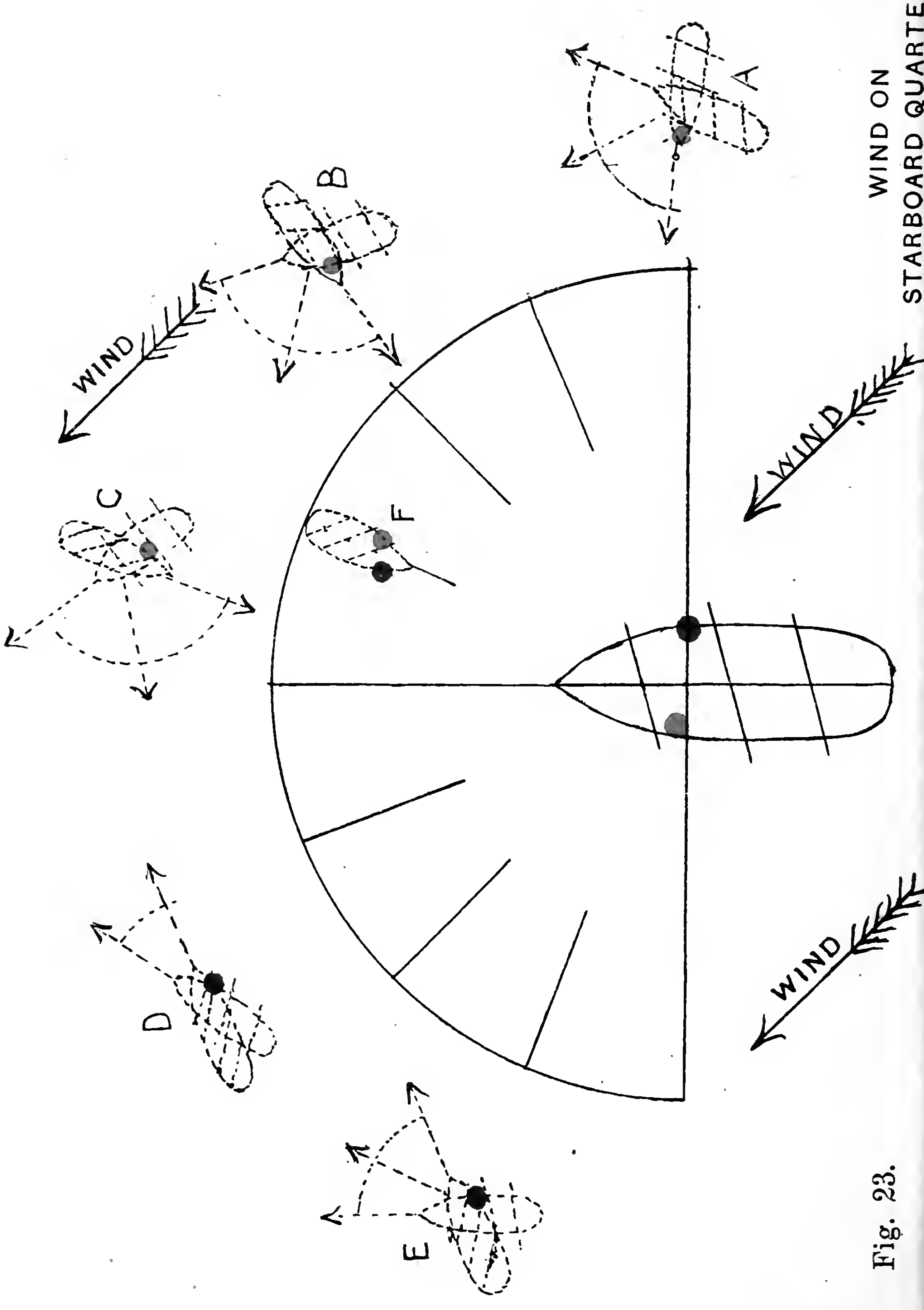
Q. You see two coloured lights two points on the weather bow ?

Ans. Keep clear. the other ship is close hauled on the port tack. Fig. 23, F.

Close hauled on Starboard Tack.

Q. You see a green light anywhere within four points on the lee bow, what would you do ?

Ans. Stand on, the other ship is on the port tack. Fig. 24, D and E.



WIND ON STARBOARD QUARTER.

Fig. 23.

Q. You see the light to leeward ?

Ans. The other ship is going the same way, I will be the weather ship. Fig. 24, F.

Note.—In this case Art. 17 does not say which ship keeps clear. It relates more to Art. 27, although it is generally understood that the weather ship is to keep clear.

Both side lights ahead.

Q. You are close hauled on starboard tack and see both side lights of another ship ahead ?

Ans. Stand on ; the other ship is free. Fig. 24, G.

Q. Suppose you have the wind abeam on the starboard side ?

Ans. Stand on ; the other ship has the wind on the port beam. Fig. 22, H.

Q. Suppose you have the wind a couple of points abaft the beam on either side ?

Ans. Keep clear ; the other ship is close hauled.

Note. The following cases are practically the same as the previous ones, only the wind is on the opposite side.

Wind abeam on Port side.

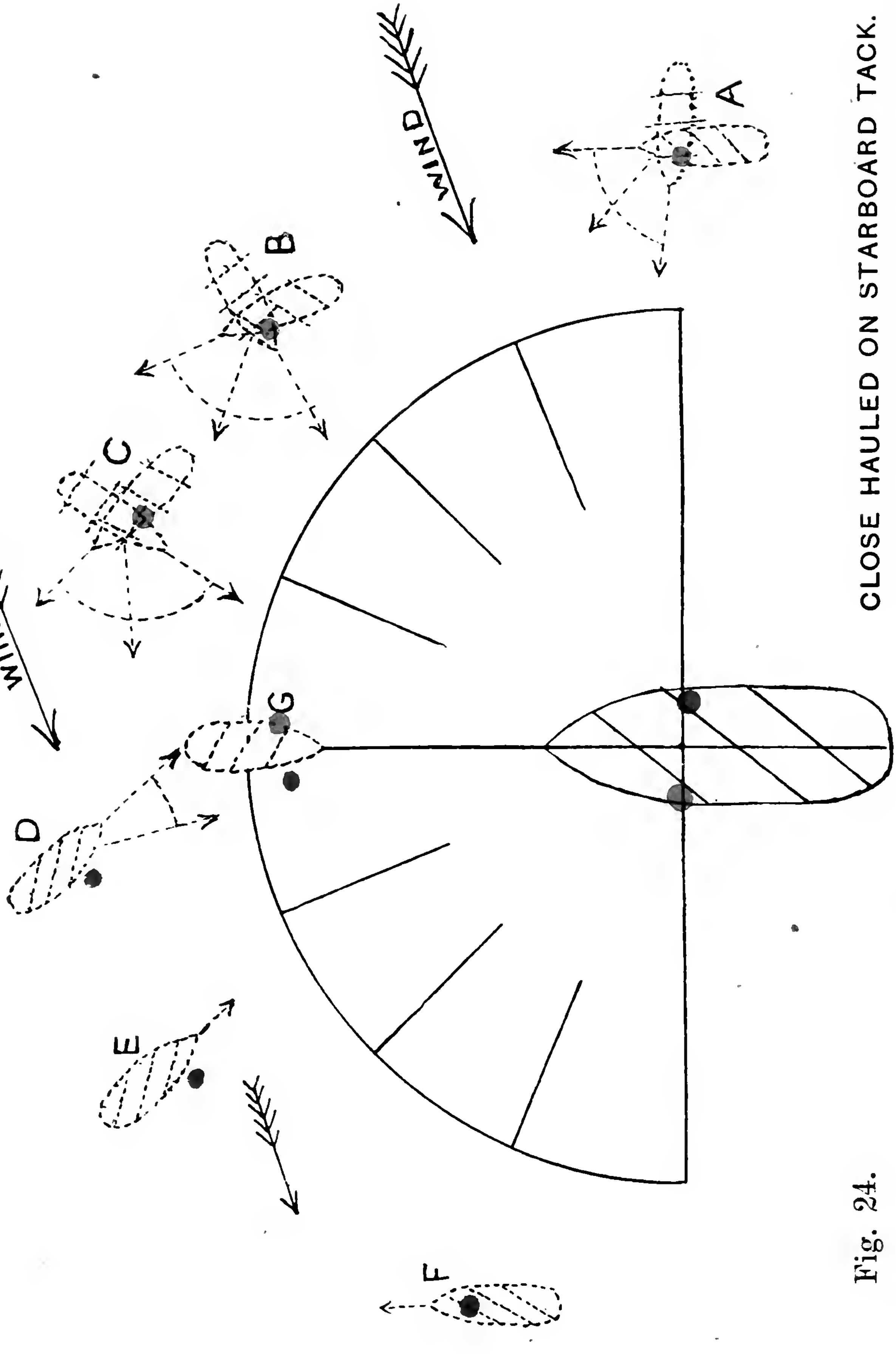
1. A green light on the weather beam must keep clear, as she is the weather ship, having the wind anywhere on the port side. Fig. 25, A.

2. A green light four points on the weather bow would have to keep clear, as she is the weather ship or got the wind aft. Fig. 25, B.

3. A green light a point and a half on the weather bow can have the wind aft and would keep clear, but she can also have the wind on the starboard quarter, then you would have to keep clear because you are running free with the wind on the port side. (Ambiguous case.) Fig. 25, C.

Wind on Port quarter.

1. A green light abeam to windward would be the weather ship or have the wind aft, and would have to keep clear. Fig. 26, A.



CLOSE HAULED ON STARBOARD TACK.

Fig. 24.

2. A green light on the weather bow would have to keep clear with the wind aft, but with the wind on the starboard quarter you would have to keep clear, because you are free with the wind on the port side. (Ambiguous case.) Fig. 26, B, C and D.

D. can be close hauled on the starboard tack.

3. Both side lights two points on the weather bow would be close hauled on the starboard tack, consequently you keep clear, because you are a free ship. Fig. 26, H.

Close hauled on Port tack.

1. A green light on the weather beam would be going the same way, or running free with the wind on the same side. Fig. 27, A.

2. A green light four points on the weather bow would be free and to windward, or wind aft. Fig. 27, B.

3. A green light two points on the weather bow would be free and to windward or have the wind aft. Fig. 27, C.

4. In the above three cases you would have to stand on.

Wind abeam Port side.

1. A red light within two points on lee bow would be close hauled on starboard tack. Fig. 25, D.

2. A red light three points on lee bow would be in stays. Fig. 25, E.

3. A red light more than four points on lee bow would be on the same tack. Fig. 25, F.

4. Both side lights two points on the lee bow would be closed hauled on the starboard tack. Fig. 25, H.

5. In the above four cases you would keep clear, because you are a free ship.

Wind on Port Quarter.

1. A red light two points before the lee beam would be going the same way or close hauled on port tack. Fig. 26, G.

2. A red light on the lee bow would be either free or close hauled on the port tack. Fig. 26, F and E.

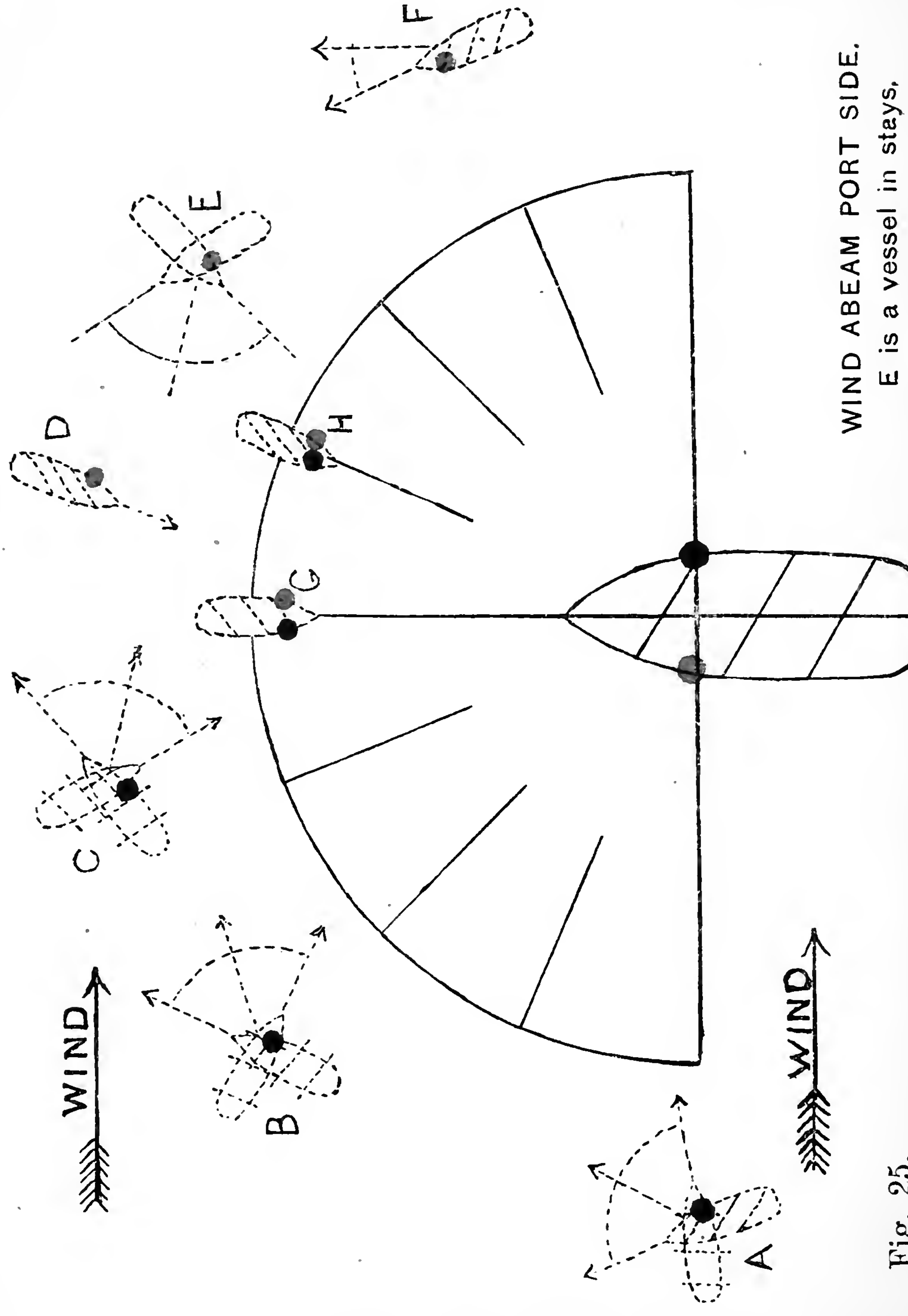

WIND ABEAM PORT SIDE.
E is a vessel in stays.
WIND
WIND
A
B
C
D
E
F
G
H

Fig. 25.

3. In the above two cases you would have to give way, because you are the weather ship.

Close hauled on Port Tack.

1. A red light within four points on the lee bow would be on the opposite tack close hauled, Fig. 27, E, and I would have to give way, but it is possible that a red light one point on the lee bow can be free, Fig. 27, D, then I should have to stand on, but D is more likely to be close hauled; if so, I keep clear.

2. A red light more than four points on the lee bow would be going the same way, and I should most likely luff a little to let the other ship get ahead, unless he went ahead himself by keeping his ship away a little. (Art. 27.) Fig. 27, F.

Note.—Art. 17 is silent on this case, but as previously remarked, it is generally understood the weather ship will keep clear.

3. Both side lights ahead would be a free ship, and I should stand on. Fig. 27, G.

Both Side Lights Ahead.

Q. You are close hauled on the port tack and see both side lights of another ship ahead?

Ans. Stand on; the other ship is free. Fig. 27, G.

Q. Suppose you have the wind abeam on the port side?

Ans. Keep clear; the other ship has the wind on the starboard beam. Fig. 25, G.

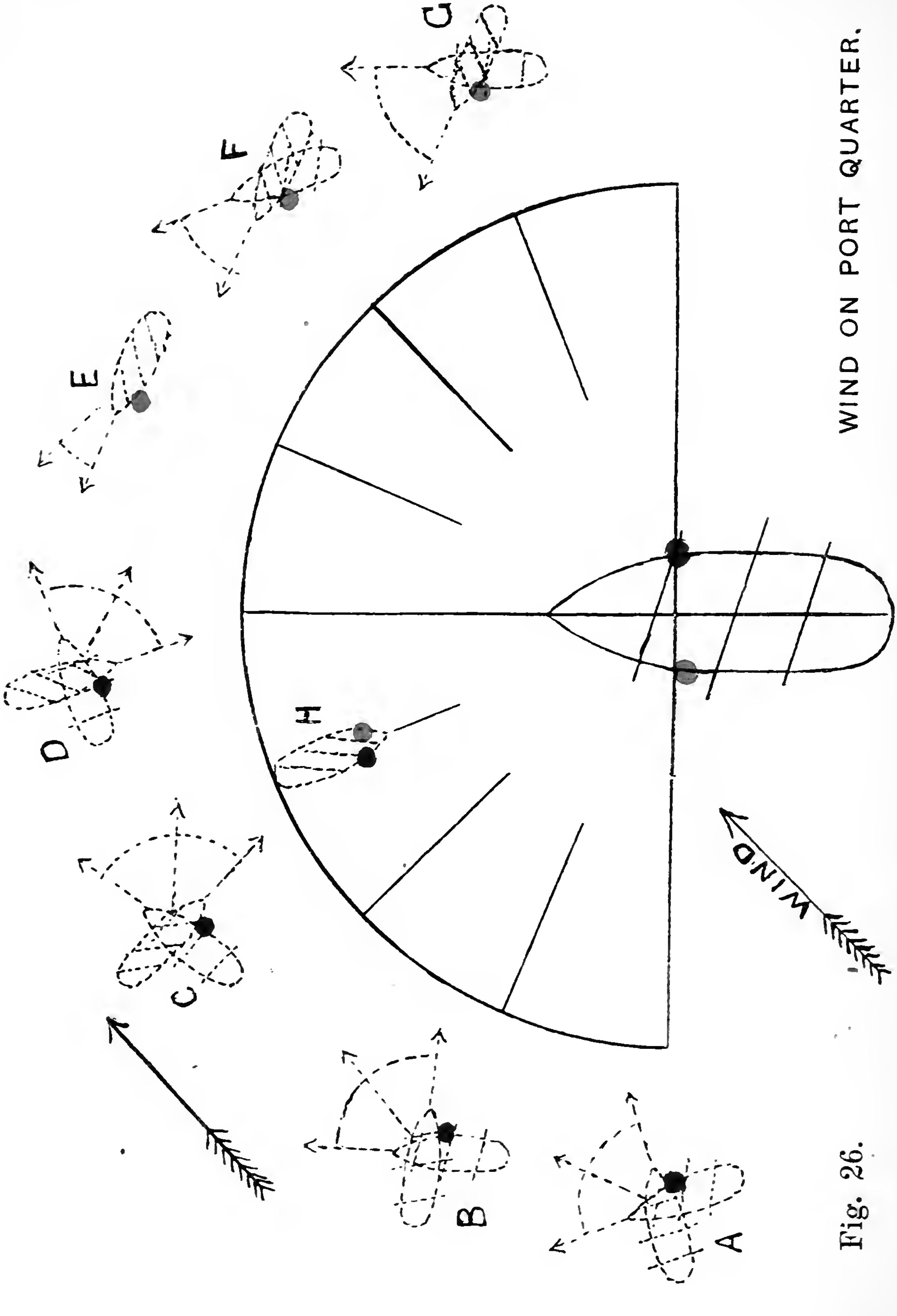
Q. Suppose you have the wind two points abaft the beam on either side?

Ans. Keep clear, the other ship is close hauled.

Special Cases.

Q. It is hazy, you are running with the wind on starboard quarter, and suddenly you see a red light two points on the weather bow; what would you do?

Ans. Luff. (Art. 27.) The other ship is running across your bow; and it would be impossible for her to get out of the way.



WIND ON PORT QUARTER.

Fig. 26.

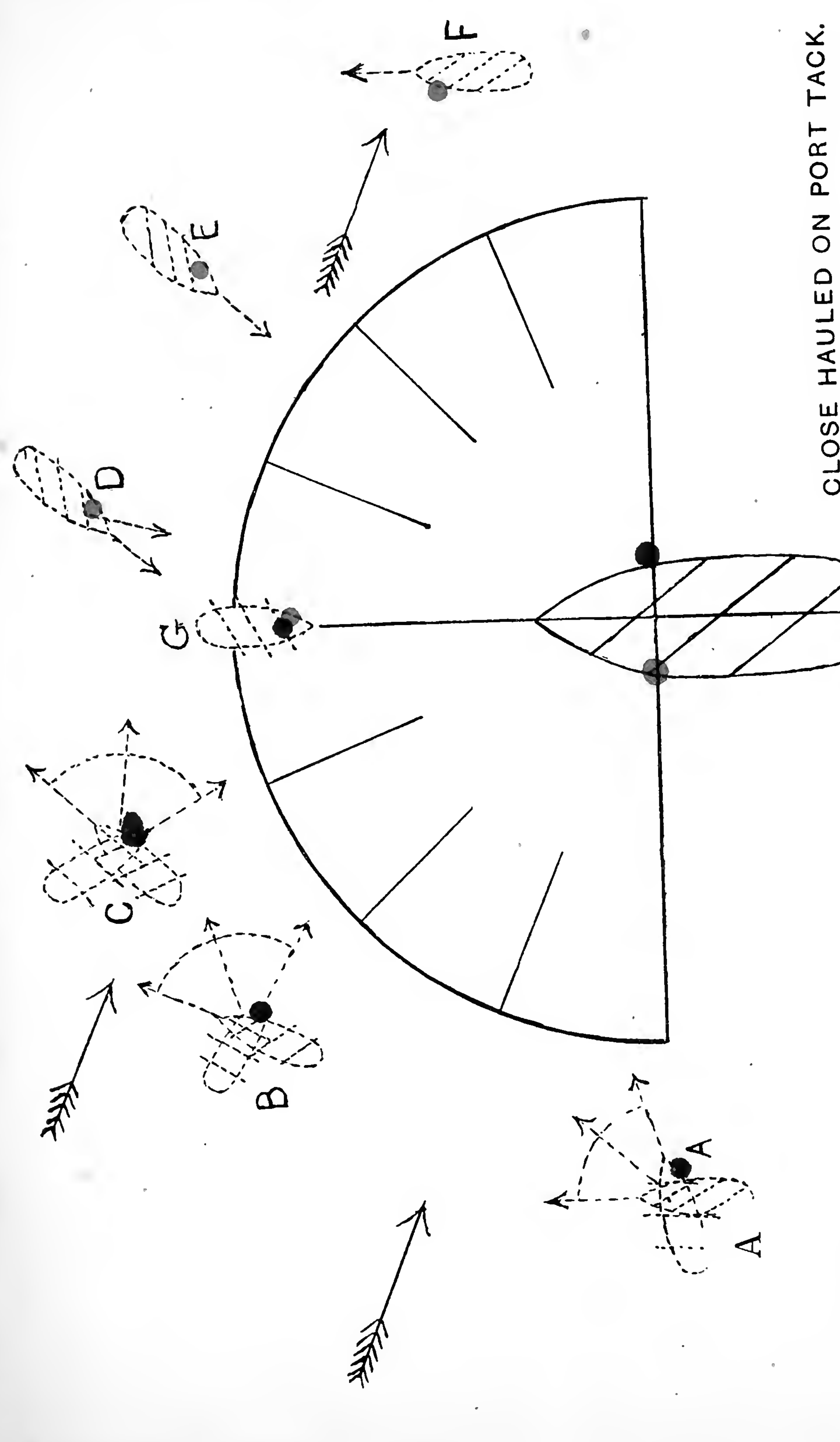


Fig. 27.

Q. It is hazy, you are in a steamship and suddenly see a green light on your port bow, very close, what would you do?

Ans. Go full speed astern, or anything that I thought would be best to avert collision. (Arts. 21—note, and 27.)

Q. In a steamer running with the wind aft, you hear on your starboard bow during a dense fog one blast from a fog horn, what would you do?

Ans. Keep my course, the fog signal is a sailing vessel on the starboard tack, and consequently all clear.

Q. You are steaming head to wind and hear two blasts on your port bow during a fog, what would you do?

Ans. Stop my engines or go astern, the fog signal is a sailing vessel on the port tack, and consequently crossing my bow.

NOTE.—The Candidate is advised to practice similar examples with the wind from all directions.

INSTRUCTIONS FOR USING THE MORTAR AND ROCKET APPARATUS FOR SAVING LIFE.

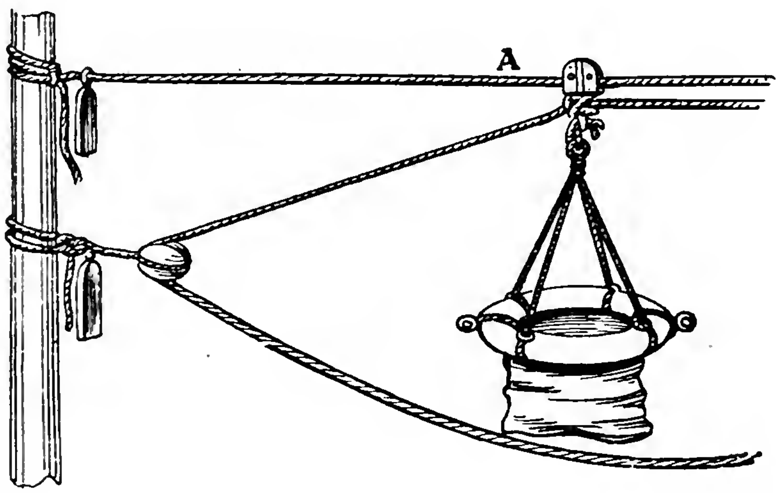
In the event of your vessel stranding within a short distance of the United Kingdom, and the lives of the crew being placed in danger, assistance will, if possible be rendered from the shore in the following manner, namely:

1.—A rocket with a thin line attached will be fired across your vessel. Get hold of this line as soon as you can and when you have secured it, let one of the crew be separated from the rest, and if in the day time, wave his hat or his hand, or a flag or handkerchief; or if at night let a rocket, a blue light, or a gun be fired, or let a light be waved as a signal to those on shore.

2.—When you see one of the men on shore separated from the rest wave a *Red* Flag, or (if at night) wave a *Red* Light, you are to haul upon the rocket line until you get a tailed block with an endless fall rove through it.

3.—Make the tail of the block fast to a mast, well above the deck, or if your masts are gone to the best place that can be found, bearing in mind that the lines should be kept clear from chafing the wreck, and that space is left above for the hawser. (See paragraph 5.) When the tail block is made fast, and the rocket line unbent from the whip, let one of the crew, separated from the rest, make the signal required by Article 1 above.

Fig. 28.



4.—As soon as the signal is seen on shore, a hawser will be bent to the whip line, and will be hauled off to the ship by those on shore.

5. When the hawser is got on board, the crew should at once make it fast to the same part of the ship as the tail block is made fast to, only, about 18 inches higher, taking care that there are no turns of the whip-line round the hawser. The whip should then be unbent from the hawser.

6.—When the hawser has been made fast on board, the signal directed to be made in Article 1 above is to be repeated.

7.—The men on shore will then pull the hawser taut, and by means of the whip-line haul off to the ship a sling *life buoy*, into which the person to be hauled ashore is to get. When he is in and secure, one of the crew must be separated from the rest, and again signal to the shore as directed in Article 1 above. The people on shore will then haul the person in the sling to the shore, and when he has landed, will haul back the empty sling to the ship for others. This operation will be repeated until all persons are landed.

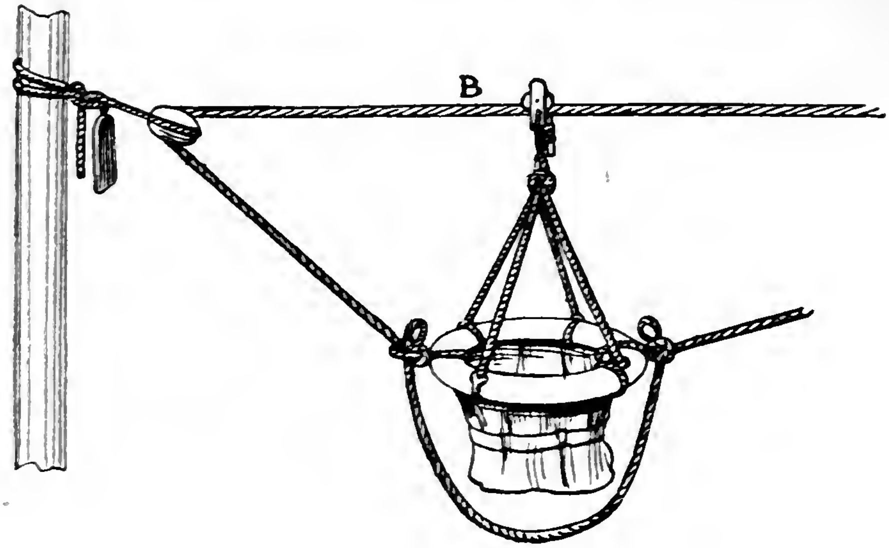


Fig. 29.

8. It may sometimes happen that the state of the weather and the condition of the ship will not admit of a hawser being set up; in such a case a *sling life buoy* will be hauled off by the whip which will be used without the hawser. Fig. 29.

Masters and crews of stranded vessels should bear in mind that SUCCESS in landing them in a great measure DEPENDS UPON THEIR COOLNESS & ATTENTION TO THE RULES HERE LAID DOWN; and that by attending to them many lives are annually saved by the Mortar and Rocket Apparatus on the coasts of the United Kingdom.

The system of signalling must be strictly adhered to; and all women, children, passengers, and helpless persons should be landed before the crew of the ship.

WORMING, PARCELLING AND SERVING.

To Worm.—Fill up the lay of the rope with spunyarn (worming with the lay) so as to make the surface of the rope even enough to parcel and serve.

To Parcel.—Pass round the rope (with the lay) pieces of tarred canvas about 2 inches in width, each turn slightly overlapping the previous one. When parcelling rigging always parcel upwards, so as to shed the water.

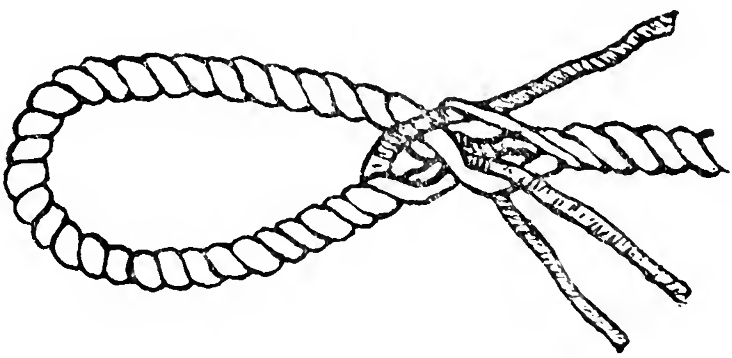
To Serve.—Two hands are usually necessary, one to turn the serving board or mallet, the other to pass the ball of spunyarn. Always serve the reverse way to parcelling and worming—against the lay.

> Worm or parcel with the lay,
> Turn and serve the other way.

SPLICING.

Eye Splice.—Unlay the strands a few inches, and place them on the standing part of the rope at such a distance as is necessary for the size of the eye. Enter the middle strand (unlaid) under a strand of the standing part of the rope, do likewise with the other two on their respective sides; taper each end and pass them through again. If neatness is desired, reduce the ends and pass them through once more; cut off smooth and serve the splice (if necessary) with spunyarn. (Fig. 30.)

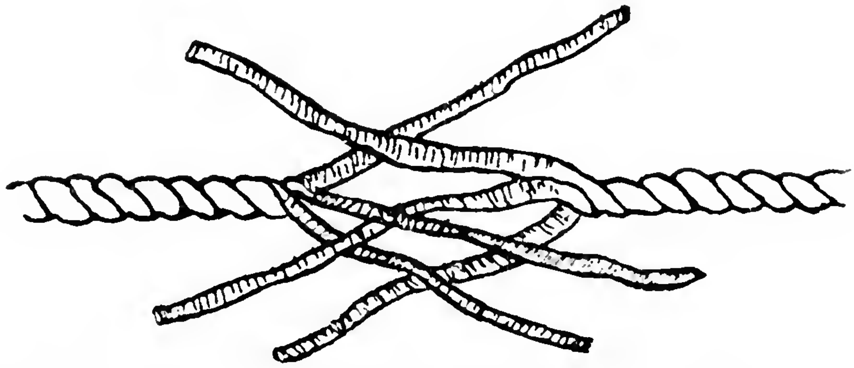
Fig. 30.



EYE SPLICE.

Short Splice.—Unlay each end a few inches, and crutch or marry them together; then pass each strand over

Fig. 31.

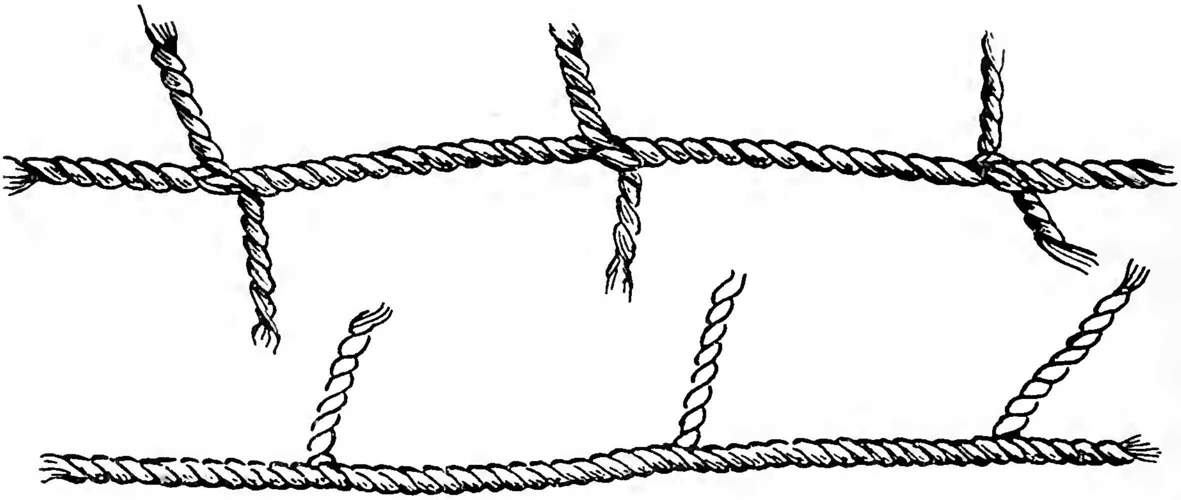


SHORT SPLICE.

one and under the next, twice each way. If neatness is desired, the strands should be halved before tucking the second time.

Long Splices.—Unlay the strands at each end about three time as much (or more) as for a short splice ; marry the two parts together, then unlay one strand still further, and follow up in the vacant space with the corresponding strand of the other part till only a few inches remain. Do likewise on the other side. There will then remain two long strands in the middle and a long and short on each side. The splice is now divided into three distinct parts. Divide the strands at each part, and tie the corresponding divisions together ; then tuck each end in twice, dividing the strands again, if necessary, at the second tucking. This and all other splices, should be well stretched and hammered into shape before cutting off the ends.

Fig. 32.



LONG SPLICE.

KNOTS, HITCHES, AND BENDS.

(1.) Simple or Overhand.

Pass the end of the rope round the standing part, and through the bight.

(2.) Figure of Eight.

Pass the end of the rope round the standing part, under its own part, and through the bight.

(3.) *Handspike Hitch.*

Place the spike on the rope and form a bight with the parts crossed, the spike being through the bight; then dip the spike under the underneath part of the rope and through the bight.

(4.) *Sheet or Common Bend.*

Pass the end of one rope through the bight formed by another, then round the two parts of this second rope and under the standing part of the first.

(5.) *Bowline.*

Place the end part on the standing part, and form a loop with the end through; pass the end under the standing part and bring it back through the loop.

(6.) *Marling Hitch.*

Make an overhand knot, and continue them about every two inches along the rope.

(7.) *Reef Knot.*

Pass the end of one part round the end part of the other, then bring the two ends back towards their standing parts, passing one part round the other again, so that the two parts of each end reeve through the bight the same way.

(8.) *Sheet Bend with Toggle.*

Pass the toggle through the middle of the knot.

(9.) *Carrick Bend.*

Pass the end of one rope through the crossed bight of another round the standing part, over the end part, and up through the loop under the standing part, both parts coming out at different sides.

(10.) *Slip.*

Pass the end of the rope round the standing part, and bring the bight formed by the end part through the bight formed by the standing part.

(11.) *Flemish Loop.*

Make a slip knot, and bend on overhand knot round the standing part.

(12.) *Chain Knot with Toggle.*

A chain knot with toggle is a succession of slip knots, the standing part being brought through each loop, and a toggle put through the last one.

(13.) *Bowline on the Bight.*

Place the bight over the two end parts, and form a loop with the bight through; pass the bight under the two end parts, and bring it back, through which reeve the bight formed by the double parts.

(14.) *Sheep Shank.*

Lay the bight of the rope in three parts, and hitch each end part round the bight of the other two parts.

(15.) *Cat's Paw.*

Take the bight of the rope in both hands, and form two bights, one in the left hand and the other in the right; roll these two bights along the end parts four or five turns.

(16.) *Half Hitch.*

Pass the end round the spar and standing part; then reeve under its own part.

(17.) *Timber Hitch.*

Pass the end round the spar and its own standing part; then pass several turns round its own part.

(18.) *Clove Hitch.*

Pass the end round the spar, crossing the standing part; then round the spar again, bringing the end through between the end part and standing part under its own part.

(19.) *Rolling Hitch.*

Pass the end twice round the spar, crossing the standing part on the top side each time; then hitch the end round the spar on the opposite side of the two turns.

(20.) *Timber Hitch and Half Hitch.*

Pass the end round the spar and over its own part, then make the timber hitch.

(21.) *Blackwall Hitch.*

Pass the end round the back of the hook, and under its own part, the end on one side of the hook and standing part on the other.

(22.) *Fisherman's Bend.*

Pass the end twice round the ring and under the turns. Stop the end back.

(23.) *Round Turn and Half Hitch.*

Pass the end twice round the ring, and make a half hitch round the standing part, stopping the end back to the standing part.

(24.) *Wall Knot Commenced.*

Unlay the strands sufficiently to form the knot, then form a bight with strand 1 and pass strand 2 round the end of it, also strand 3 round the end of 2 and through the bight of one.

(25.) *Wall Knot Completed.*

Haul taut the ends, taking care to properly form the knot.

(26.) *Crown Commenced.*

Lay strand 1 over the centre of the wall, strand 2 over 1, and strand 3 over 2 and under 1.

(27. *Crown Completed.*

Haul the strands taut and form the knot.

KNOTS, HITCHES, AND BENDS.

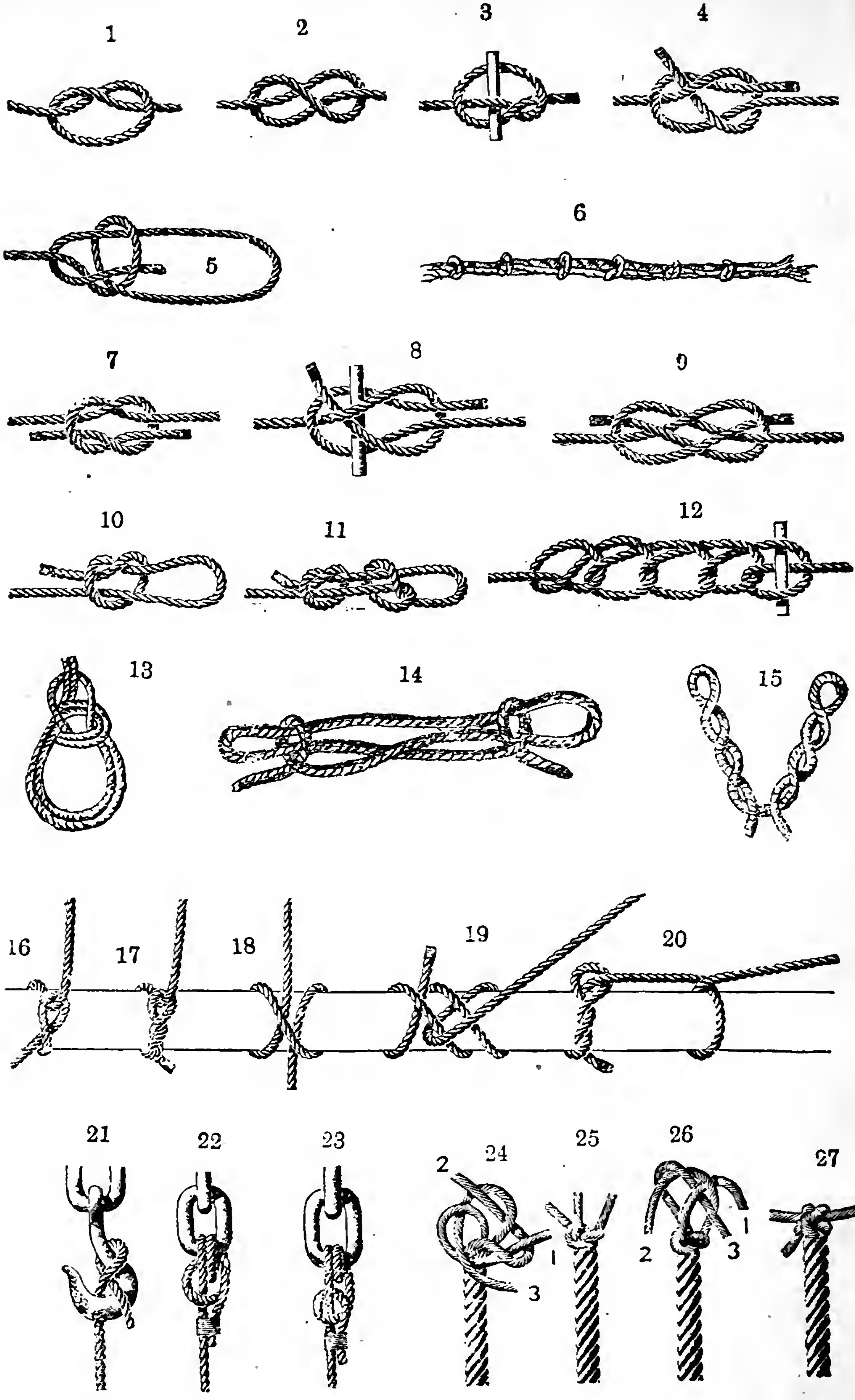


Fig. 33.

A FOUR-MASTED SHIP.*

The vessel illustrated in the two Plates, although not of the latest type, is purposely selected and at the same time exhibits the great advance made in the construction of merchant sailing ships. To the eye there is no very great difference between a large three-master and a four-master, but the latter possesses several advantages over the former. In a four-masted vessel the masts, yards, and sails do not require to be so large as in a three-master in order to receive an equal wind-pressure, the rigging has less height and greater spread transversely, and consequently there is less difficulty in working the ship, and less danger of dismasting. The wind pressure is also more equally distributed fore and aft, and the centre of effort of the sails being lower down, the vessel heels over less and thus gains in speed, also answering better to her helm. Another advantage is that such vessels can be more easily managed in tacking and wearing at sea owing to the jigger-mast and fore-mast being nearer the ends of the ship, and thus giving a more powerful leverage when required In the plate the fourth or jigger mast is barque-rigged but it is often square-rigged like the others. A further advantage is that the dimensions of the three foremost masts and their yards can be so arranged that all the principal sails are interchangeable, so that only a limited number of spare sails is required. The vessel shewn in the plate carries upper and lower topsails and topgallant sails : this is an improvement that had been previously introduced in three-masted vessels. The adoption of the four-masted rig has enabled larger sailing vessels to be introduced than was found practicable with three masts, 2300 tons being about the extreme tonnage of three-masters, while four-masters range from about 2000 to 4000 tons. From their greater handiness, too, these vessels can be managed by a relatively smaller number of hands, and are thus less expensive to navigate.

* These two drawings of Ships are taken from "Ogilvie's Imperial Dictionary," by kind permission of Messrs. Blackie & Son, of Glasgow, Publishers.

TERMS APPLIED TO THE HULL, SPARS AND STANDING RIGGING. (Fig. 34.)

THE HULL.

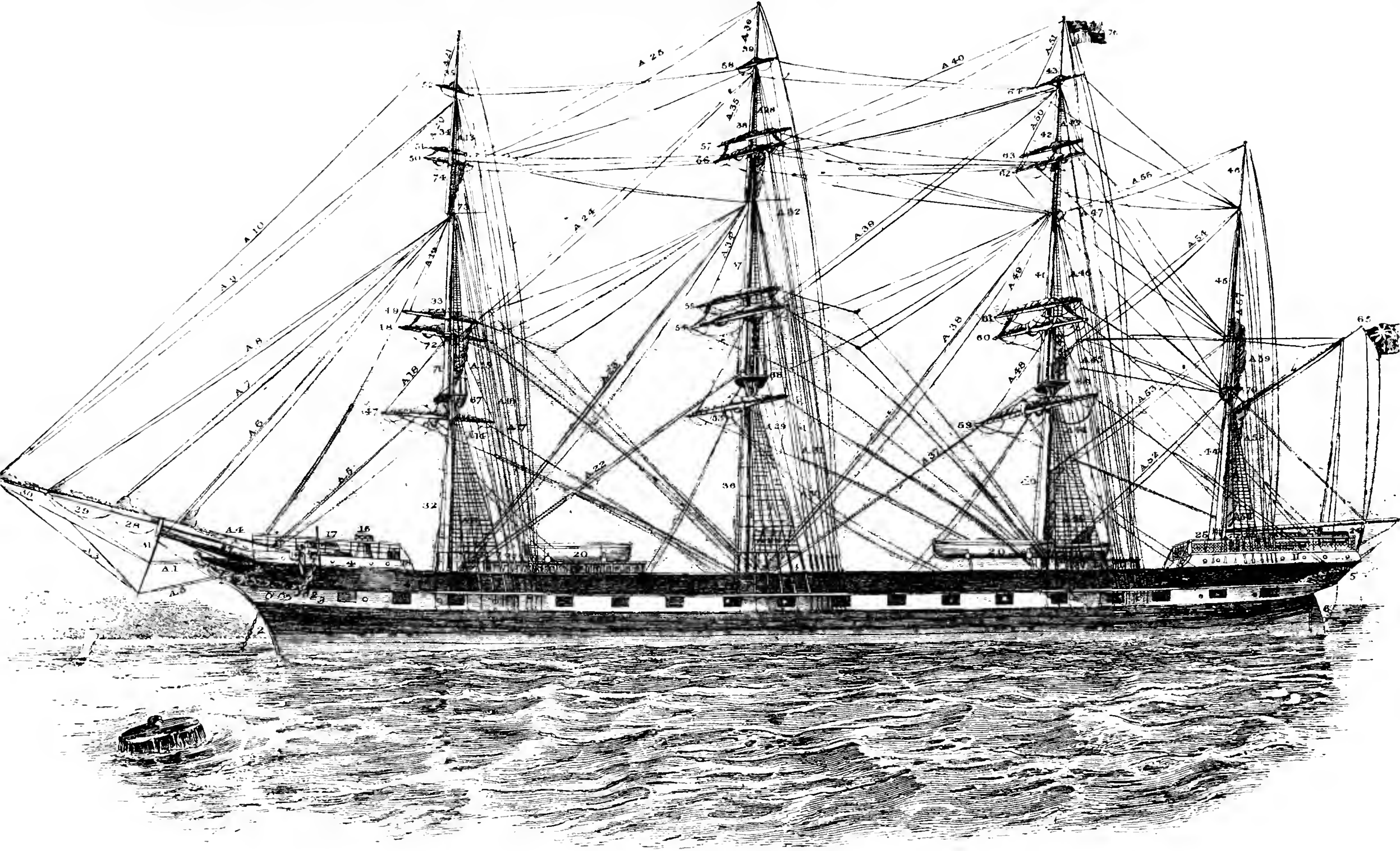
1 Head
2 Cutwater
3 Bow
4 Forecastle-deck
5 Stern
6 Rudder
7 Fore-chains
8 Main-chains
9 Mizzen-chains
10 Bulwarks
11 Poop-deck
12 Gun-ports
13 Trail-boards
14 Cat-head
15 Head-rails
16 Capstan
17 Skylight
18 Light-boards
19 Fore-deck house
20 Life-boats
21 Gig
22 Companion
23 Skylight
24 Wheel-box
25 Poop-rails
26 Afterdeck-house

THE SPARS.

27 Bowsprit
28 Inner jib-boom
29 Outer jib-boom
30 Flying jib-boom
31 Martingale
32 Fore-mast
33 Fore-topmast
34 Fore-topgallant mast
35 Fore-royal mast
36 Main-mast
37 Main-topmast
38 Main-topgallant mast
39 Main-royal mast
40 Mizzen-mast
41 Mizzen-topmast
42 Mizzen-topgallant mast
43 Mizzen-royal mast
44 Jigger-mast
45 Jigger-topmast
46 Jigger-topgallant mast
47 Fore-yard
48 Fore lower topsail yard
49 Fore upper topsail yard
50 Fore lower topgallant yard
51 Fore upper topgallant yard
52 Fore-royal yard
53 Main-yard
54 Main lower topsail yard
55 Main upper topsail yard
56 Main lower topgallant yard
57 Main upper topgallant yard
58 Main-royal yard
59 Crossjack yard
60 Mizzen lower topsail yard
61 Mizzen upper topsail yard
62 Mizzen lower topgallant yard
63 Mizzen upper topgallant yard
64 Mizzen-royal yard
65 Jigger gaff
66 Jigger boom
67 Fore-top
68 Main-top
69 Mizzen-top
70 Jigger-top
71 Fore-doublings
72 Fore-mast cap
73 Fore-topmast cross-trees
74 Fore-topmast cap
75 Ensign
76 Company's flag

THE STANDING RIGGING.

A 1 Bobstay
A 2 Bow-sprit shroud
A 3 Martingale-stay
A 4 Jib-boom guys
A 5 Fore-stay
A 6 Fore-topmast stay
A 7 Inner-jib stay
A 8 Outer-jib stay
A 9 Flying-jib stay
A 10 Fore-royal stay
A 11 Fore-rigging
A 12 Fore-topmast rigging
A 13 Fore-topgallant rigging
A 14 Fore-cap back-stay
A 15 Fore-topmast back-stays
A 16 Fore-topgallant back-stays



[To face p. 122.]

Fig. 34.

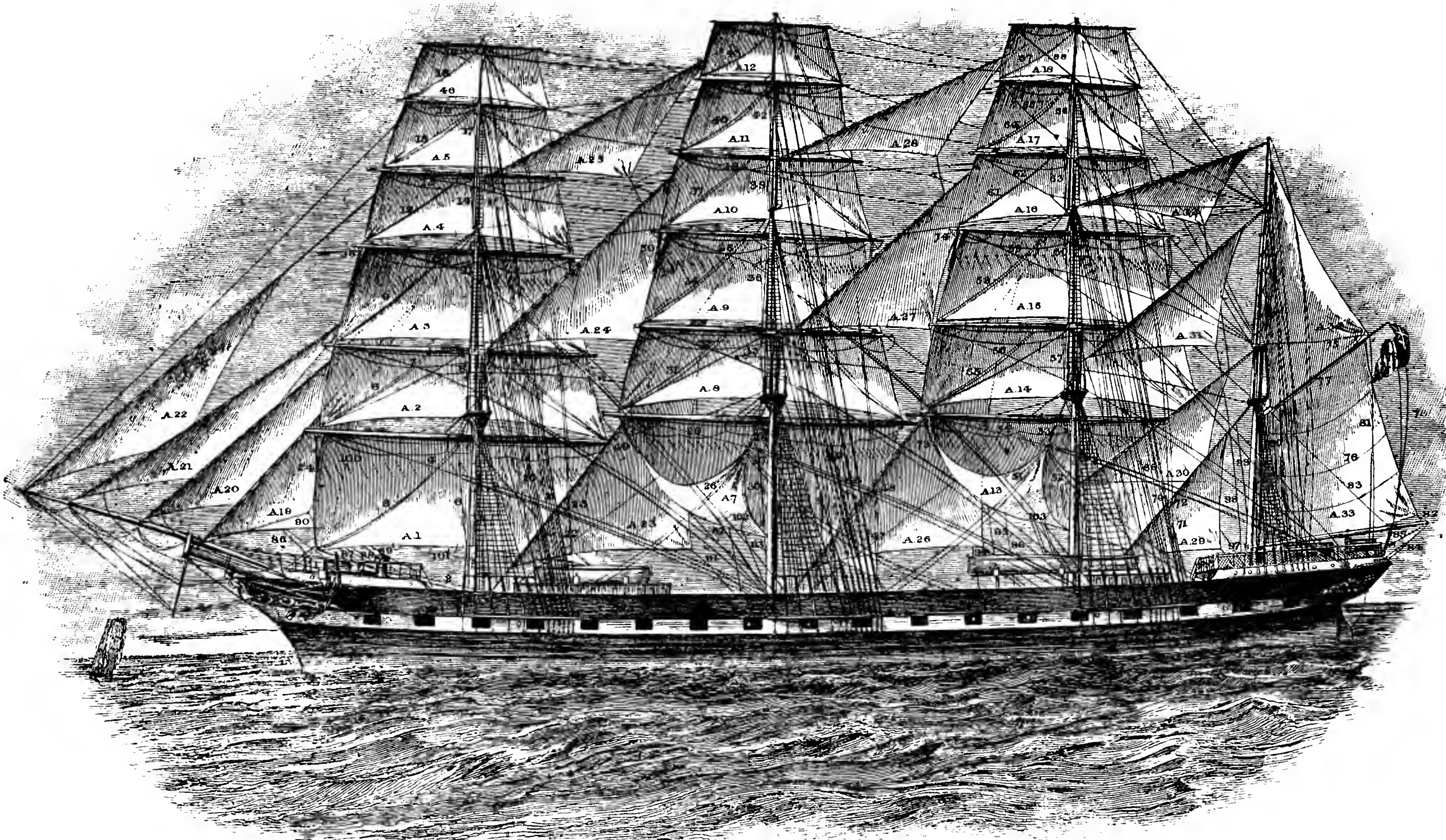

A.1
A.2
A.3
A.4
A.5
A.7
A.8
A.9
A.10
A.11
A.12
A.13
A.14
A.15
A.16
A.17
A.18
A.19
A.20
A.21
A.22
A.24
A.26
A.27
A.28
A.29
A.30
A.31
A.33

Fig. 35.

TERMS APPLIED TO THE HULL, SPARS AND STANDING RIGGING—*Continued.*

A 17 Fore-royal back-stay
A 18 Fore-lift
A 19 Fore-topsail lift
A 20 Fore-topgallant lift
A 21 Fore-royal lift
A 22 Main-stay
A 23 Main-topmast stay
A 24 Main-topgallant stay
A 25 Main-royal stay
A 26 Main-rigging
A 27 Main-topmast rigging
A 28 Main-topgallant rigging
A 29 Main-cap back-stay
A 30 Main-topmast back-stays
A 31 Main-topgallant back-stays
A 32 Main-royal back-stays
A 33 Main-lift
A 34 Main-topsail lift
A 35 Main-topgallant lift
A 36 Main-royal lift
A 37 Mizzen-stay
A 38 Mizzen-topmast stay
A 39 Mizzen-topgallant stay
A 40 Mizzen-royal stay
A 41 Mizzen-rigging
A 42 Mizzen-topmast rigging
A 43 Mizzen-topgallant rigging
A 44 Mizzen-cap back-stay
A 45 Mizzen-topmast back-stays
A 46 Mizzen-topgallant back-stays
A 47 Mizzen-royal back-stay
A 48 Cross jack lift
A 49 Mizzen-topsail lift
A 50 Mizzen-topgallant lift
A 51 Mizzen-royal lift
A 52 Jigger-stay
A 53 Jigger middle stay
A 54 Jigger-topmast stay
A 55 Jigger-topgallant stay
A 56 Jigger-rigging
A 57 Jigger-topmast rigging
A 58 Jigger-topmast back-stays
A 59 Jigger-topgallant back-stays

TERMS APPLIED TO THE SAILS AND RUNNING RIGGING. (Fig. 35.)

THE SAILS.

A 1 Fore-sail
A 2 Fore lower topsail
A 3 Fore upper topsail
A 4 Fore lower topgallant sail
A 5 Fore upper topgallant sail
A 6 Fore-royal
A 7 Main-sail
A 8 Main lower topsail
A 9 Main upper topsail
A 10 Main lower topgallant sail
A 11 Main upper topgallant sail
A 12 Main-royal
A 13 Crossjack
A 14 Mizzen lower topsail
A 15 Mizzen upper topsail
A 16 Mizzen lower topgallant sail
A 17 Mizzen upper topgallant sail
A 18 Mizzen-royal
A 19 Fore-topmast stay-sail
A 20 Inner-jib
A 21 Outer-jib
A 22 Flying-jib
A 23 Main-topmast stay-sail
A 24 Main-topgallant stay-sail
A 25 Main-royal stay-sail
A 26 Mizzen-topmast staysail
A 27 Mizzen-topgallant stay-sail
A 28 Mizzen-royal stay-sail
A 29 Jigger stay-sail
A 30 Jigger middle stay-sail
A 31 Jigger-topmast stay-sail
A 32 Jigger-topgallant stay-sail
A 33 Jigger
A 34 Gaff topsail

THE RUNNING RIGGING.

1 Fore-tack
2 Fore-sheet
3 Fore clew-garnet
4 Fore-braces
5 Fore lower topsail sheet
6 Fore lower topsail clew-lines
7 Fore lower topsail braces
8 Fore upper topsail sheets

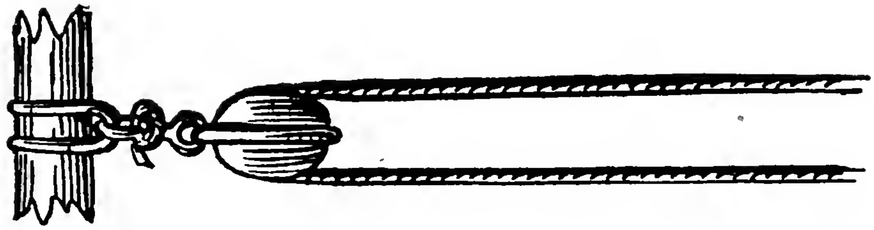
Terms applied to the Sails and Running Rigging.—*Continued.*

9 Fore upper topsail clew-lines*
10 Fore upper topsail braces
11 Fore lower topgallant sheet
12 Fore lower topgallant clew-lines
13 Fore lower topgallant braces
14 Fore upper topgallant sheet
15 Fore upper topgallant clew-lines*
16 Fore upper topgallant braces
17 Fore-royal sheet
18 Fore-royal clew-lines
19 Fore-royal braces
20 Fore-topsail halyards
21 Fore-topgallant halyards
22 Fore-royal halyards
23 Fore-signal halyards
24 Fore reef-tackles
25 Fore-topsail reef-tackles
26 Main-tack
27 Main-sheet
28 Main clew-garnet
29 Main-brace
30 Main lower topsail sheet
31 Main lower topsail clew-lines
32 Main lower topsail brace
33 Main upper topsail sheet
34 Main upper topsail clew-lines*
35 Main upper topsail braces
36 Main lower topgallant sheet
37 Main lower topgallant clew-lines
38 Main lower topgallant braces
39 Main upper topgallant sheet
40 do. do. clew-lines*
41 Main upper topgallant brace
42 Main-royal sheet
43 Main-royal clew-lines
44 Main-royal braces
45 Main-topsail halyards
46 Main-topgallant halyards
47 Main-royal halyards
48 Main signal-halyards
49 Main reef-tackles
50 Main-topsail reef-tackles
51 Crossjack tack
52 Crossjack sheet
53 Crossjack clew-garnet
54 Crossjack braces
55 Mizzen lower topsail clew-lines
56 Mizzen lower topsail braces
57 Mizzen upper topsail sheet
58 Mizzen upper topsail clew-lines*
59 Mizzen upper topsail braces
60 Mizzen lower topgallant sheet
61 Mizzen lower topgallant clew-lines
62 Mizzen lower topgallant braces
63 Mizzen upper topgallant sheet
64 Mizzen upper topgallant clew-lines*
65 Mizzen upper topgallant braces
66 Mizzen-royal sheet
67 Mizzen-royal clew-lines
68 Mizzen-royal braces
69 Mizzen-topsail halyards
70 Mizzen-topgallant halyards
71 Mizzen-royal halyards
72 Mizzen-signal halyards
73 Crossjack reef-tackles
74 Mizzen-topsail reef-tackles
75 Jigger peak-halyards
76 Jigger brails
77 Jigger gaff-topsail sheet
78 Ensign halyards
79 British ensign
80 Gaff-topsail halyards
81 Vangs
82 Jigger outhaul
83 Boom topping lift
84 Boom guys
85 Boom sheet
86 Flying-jib sheet
87 Outer-jib sheet
88 Inner-jib sheet
89 Fore-topmast stay-sail sheet
90 Fore-bowline
91 Main-topmast stay-sail sheet
92 Main-topgallant stay-sail sheet
93 Main-royal stay-sail sheet
94 Mizzen-topmaststay-sail sheet
95 Mizzen-topgallant stay-sail sheet
96 Mizzen-royal stay-sail sheet
97 Jigger stay-sail sheet
98 Jigger-topmast stay-sail sheet
99 Jigger-topgallant staysail sheet
100 Reef points
101 Fore-buntlines
102 Main-buntlines
103 Crossjack buntlines

* Most ships do not have clew-lines on upper topsail and upper topgallant sails, their clews are either shackled to the lower yard arms, or have sheets made fast in the tops.

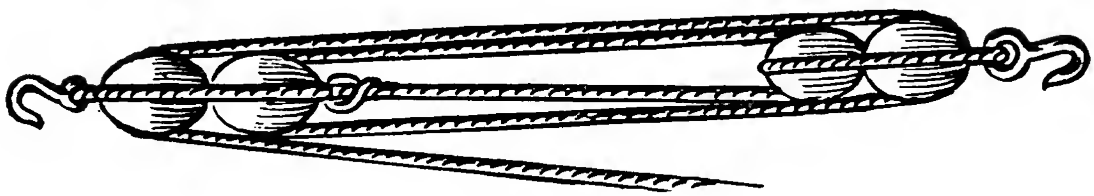
PURCHASES, &c.

Fig. 40.



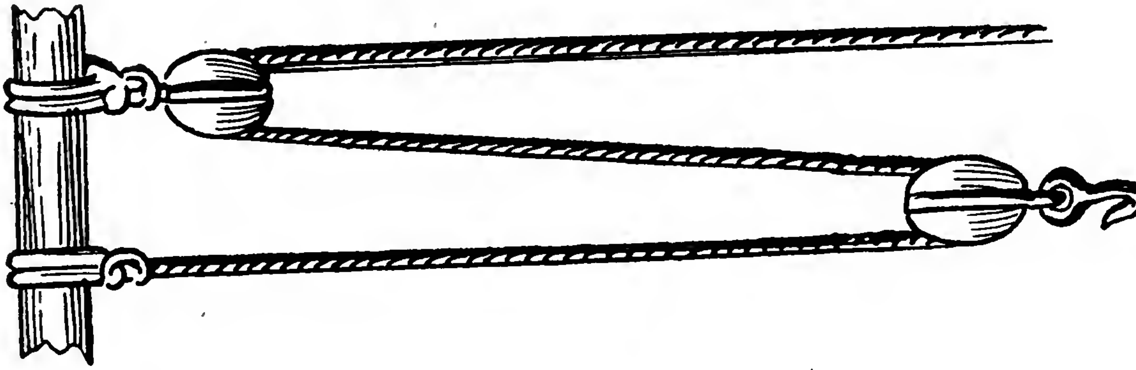
Single Whip.

Fig. 39.



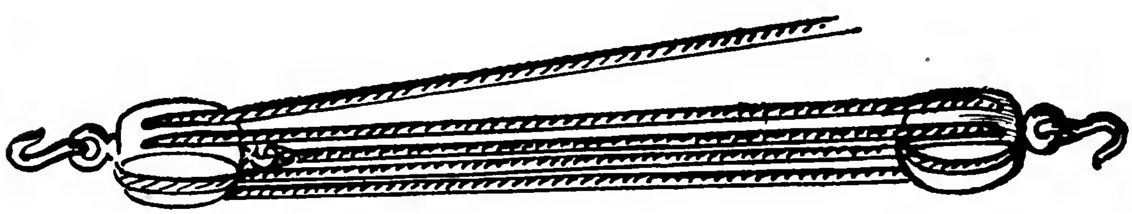
Long Tackle.

Fig. 38.



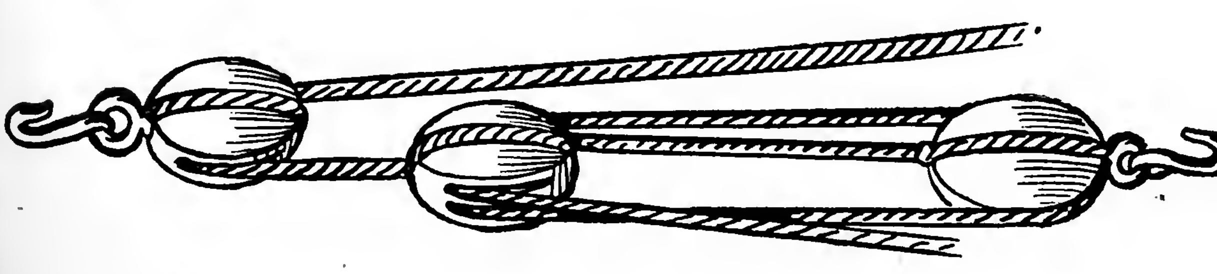
Double Whip.

Fig. 37.



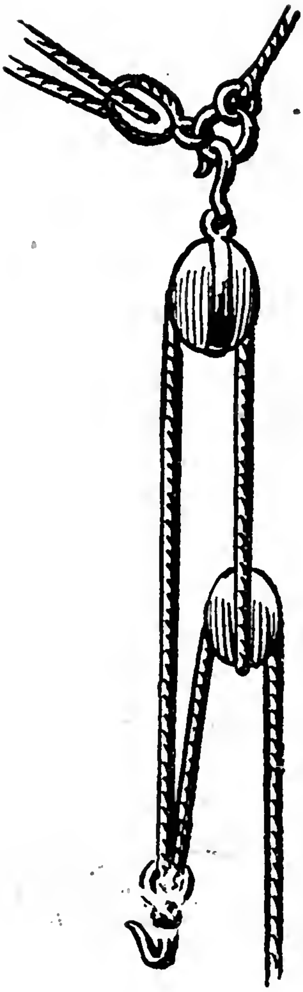
Two Fold Purchase.

Fig. 36.



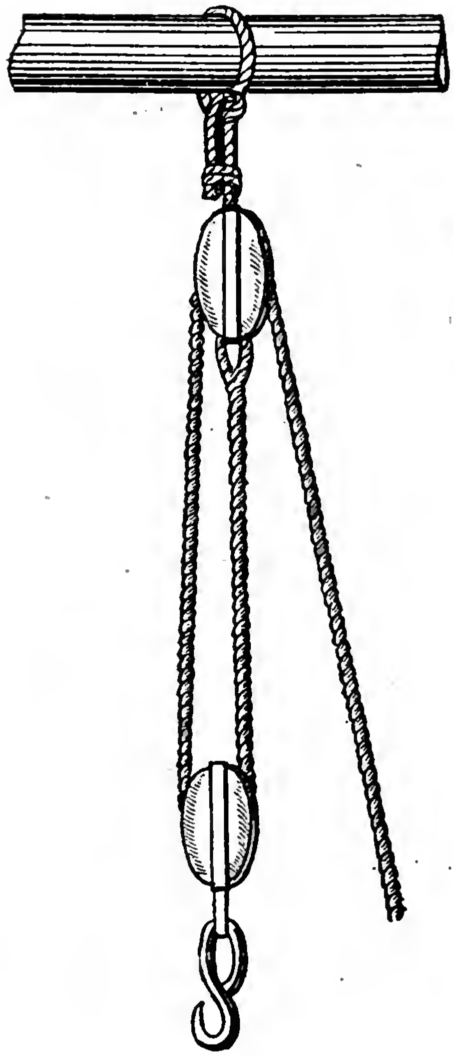
Runner & Tackle.

Fig. 41.



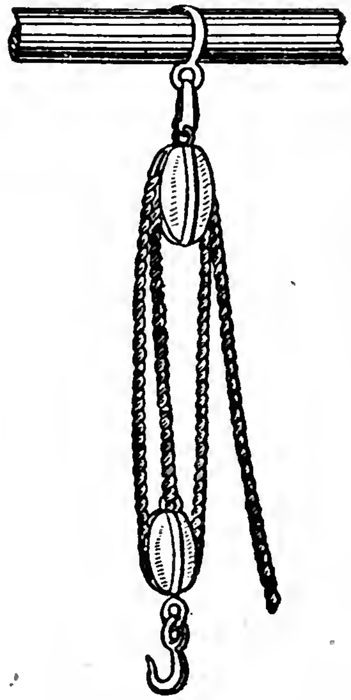
SPANISH BURTON.

Fig. 42.



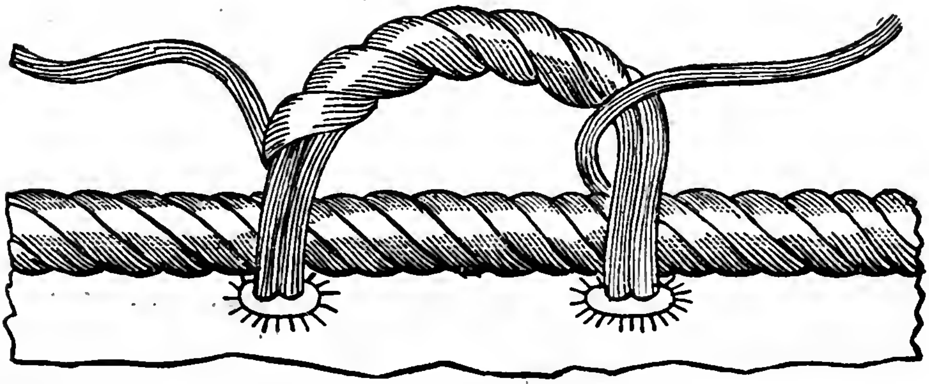
GUN TACKLE.

Fig. 43.



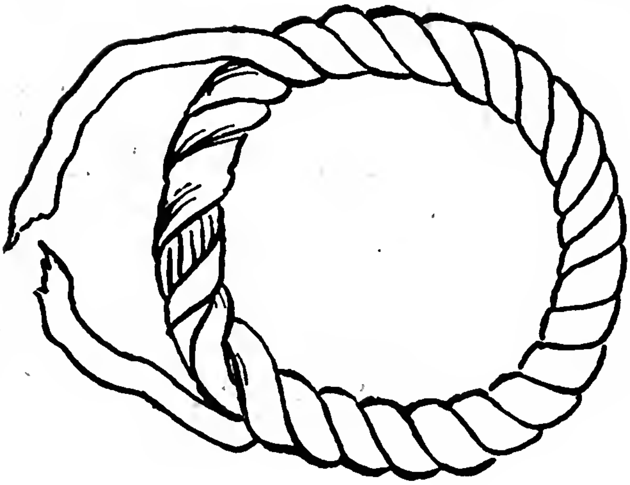
LUFF TACKLE.

Fig. 44.



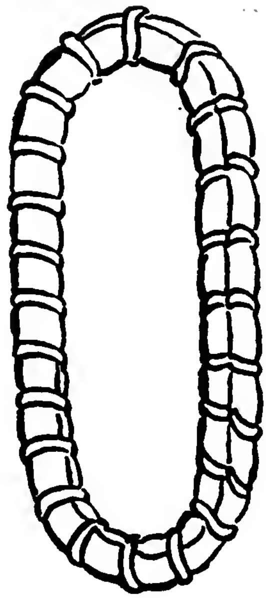
FOUR STRANDED CRINGLE.

Fig. 45.



GRUMMET.

Fig. 46.

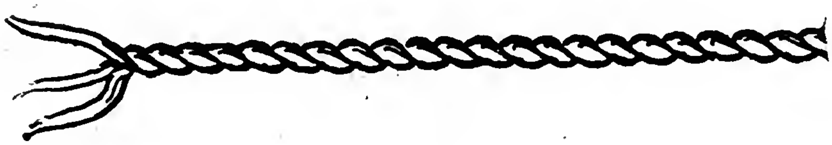


SELVAGEE STROP.

Fig. 47.

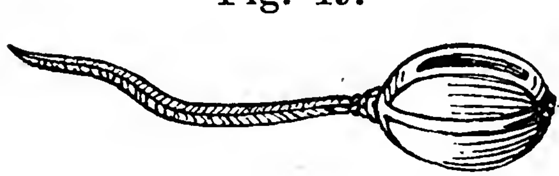
FLEMISH EYE.

Fig. 48.



HAWSER LAID ROPE.

Fig. 49.



TAIL BLOCK.

RIGGING, &c.

Candidates for Steamship Certificates should be able to answer the Questions marked **S.**

Q. If you were appointed to a ship just launched, without even her lower masts, and were required to superintend the rigging of her, what would you have sent off first ?

Ans. The spars for the sheers.

Q. How would have them placed alongside ?

Ans. Thin ends aft.

Q. How would you get them on board ?

Ans. Hang skids over the sides, and parbuckle them on board.

Q. Rig a pair of sheers ? **S.**

Ans. Place the spars over the taffrail, with their heels even, cross them near their after ends, and then put on the head lashing ; put two stout tackles on *each* heel, one to lead forward, the other aft ; have two pieces of tough wood, one at each gangway as shoes ; place a leg of the sheers on each shoe ; haul taut the after-heel tackles and belay them ; lash the upper purchase under the head lashing, middle a couple of hawsers and clove-hitch them over the sheer heads, having two parts leading forward and two aft ; put a luff tackle at the end of each, to secure the sheers when the stress is on them ; shore the decks from the skin up, the heads of the shores should press against a stout plank running fore and aft under the beams near the partners ; the stress is thus divided amongst the beams instead of being concentrated on the beam the heel may at the moment rest upon. When ready, raise the sheers by heaving on the forward guys.

Q. What kind of head-lashing would you put on ?

Ans. Round lashing ; some prefer figure of eight.

Q. Where would you lash your upper purchase block ?

Ans. As close up against the head lashing as I could get it.

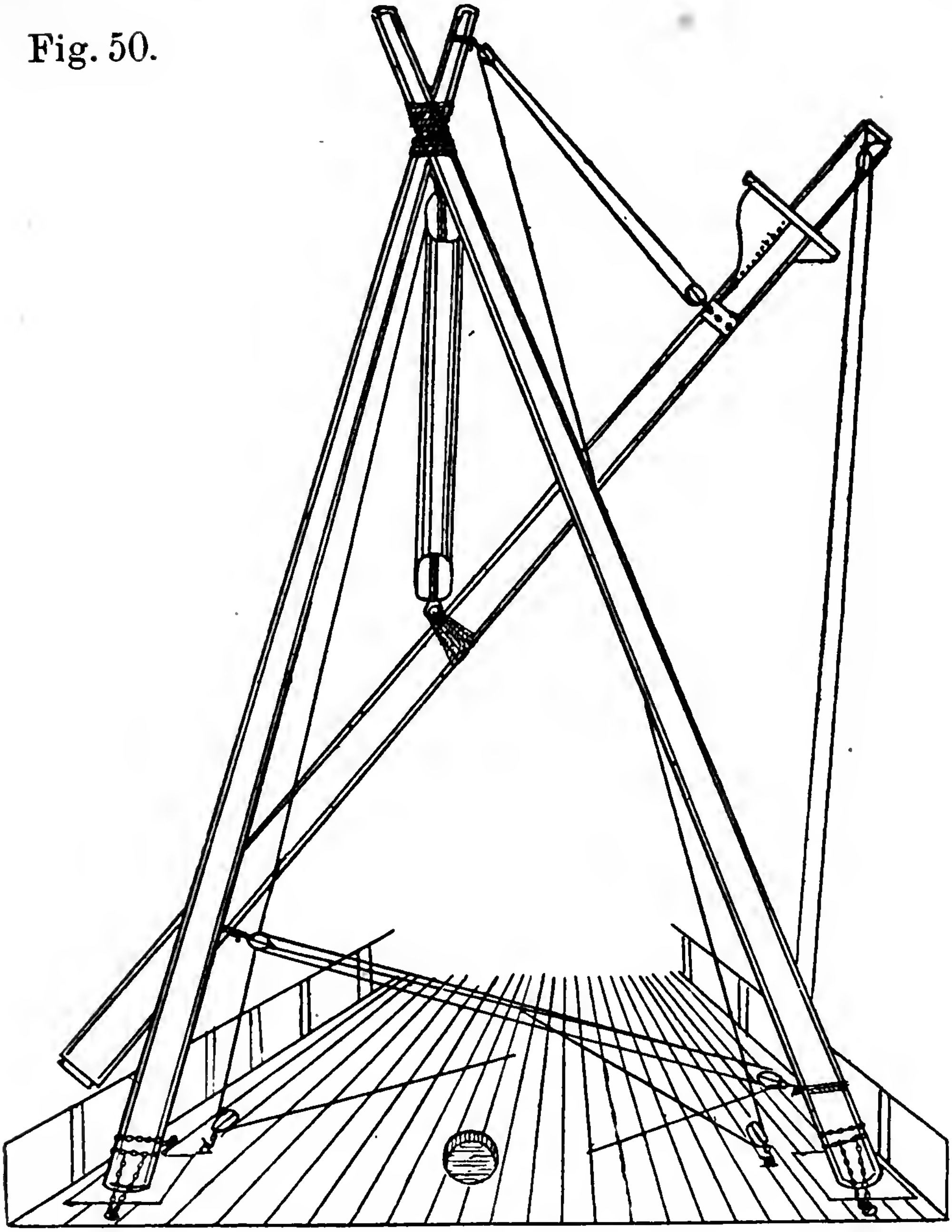
Q. What could you do to stiffen the sheers, that is, bind them to the deck better ?

Ans. Have a shroud over the heads of the sheers, a part leading down the side of each leg, and set up to ringbolts or anything that was handy.

Q. How should the mast be place alongside ?

Ans. With its head aft, and fore side uppermost.

Fig. 50.



TAKING IN LOWER MAST.

Q. Which mast would you take in first ?

Ans. The mizzen, then the main, and then the foremast.

Q. Take in your mast ?

Ans. Measure the distance from the keelson to the deck, and lay this measurement along the mast from the heel ; lash the lower purchase block a little above this mark to allow for stretching. Take the fall of the main purchase to the capstan and heave round ; make the truss tackle fast when the head appears above the rail ; when the heel rises near the rail, hook on a heel-tackle to ease it inboard ; get the mast fair for lowering by means of the truss and heel tackles ; wipe the tenon dry, and white lead or tar both it and the step ; lower away, and step the mast.

Q. What would you do as the head of the mast appears above the rail?

Ans. Put on the girtline blocks for sending up the top, and reeve the girtlines from forward.

Q. Where would you place the girtline blocks?

Ans. At the mast head where the lower cap will come.

Note.—After the mizzenmast is in, the sheers will have to be slid forward along the deck to take in the main and foremasts.

Q. What would you take in after your masts.

Ans. The bowsprit.

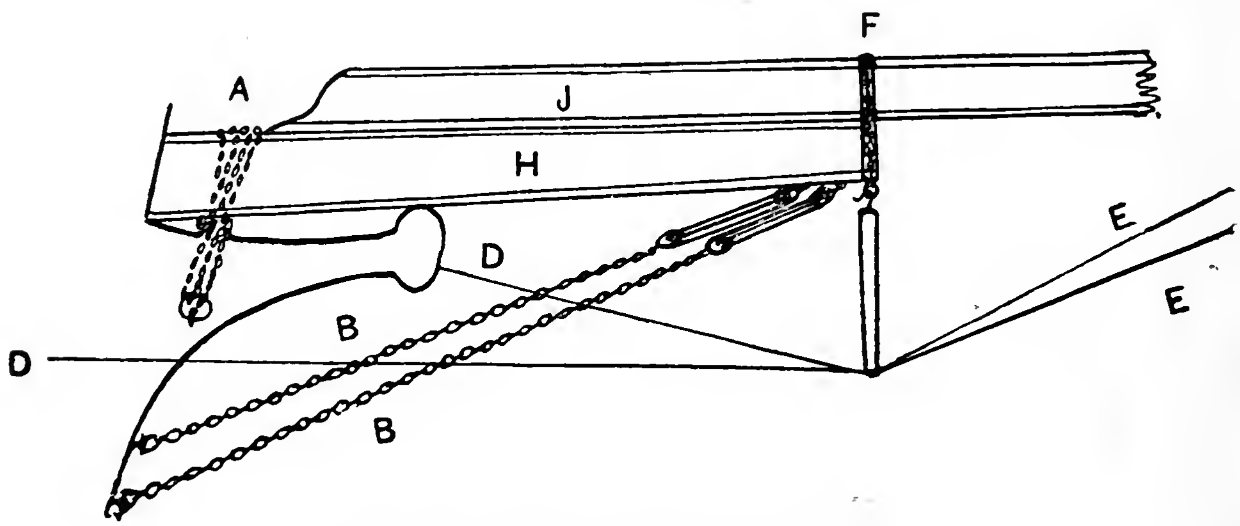
Q. How would you take it in?

Ans. Over the bows with the sheers projecting forward and guyed from the foremast.

Q. If the sheers won't rake far enough forward?

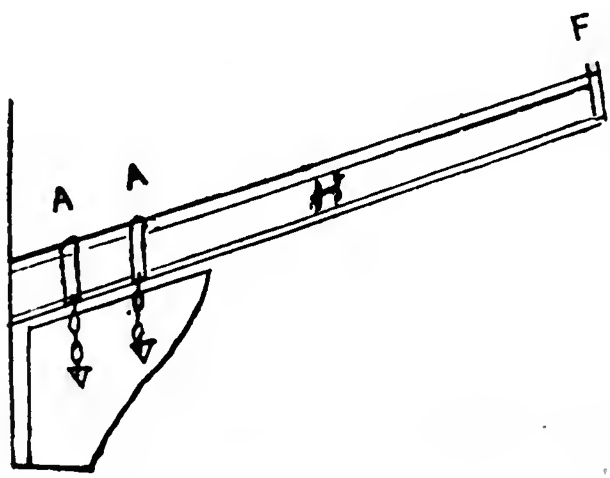
Ans. Rig a spar projecting over the bows and heave out to get the heel between the knight heads.

Fig. 51.



BOWSPRIT AND JIB-BOOM.

Fig. 52.



A Gammoning.
B Bobstay.
D Back Ropes.
E Martingale Stays.
F Cap.
H Bowsprit.
J Jib-boom.

Q. Suppose your bowsprit stepped, what would you do next? Ans. Secure it.

Q. How do you secure it?

Ans. By passing the gammoning and setting up the bobstays and shrouds.

In an iron ship the bowsprit is built into the ship, and in lieu of the gammoning, iron plates secure it to the stem. A strong iron bar is used for the bobstay.

Q. How do you get the bowsprit down so as to set it up?

Ans. Rig out the jib-boom if I had plenty of room. If I am cramped for room, hang a water-cask at the bowsprit end.

Q. Your lowermasts being now in, what would you send up first? Ans. The tops.

Q. Where would you place the top before sending it up and how?

Ans. Abaft the mast, with the fore part up and the under face against the mast.

Q. Send it up? (See Fig. 53.)

Ans. The girtlines are already rove, hitch them to the after part of the top and stop them underneath to the cross-trees and to the fore rim of the top. Have a couple of guys leading forward and one aft; then heave away, and when the rim of the tops reaches the blocks, cast off the stops, sway away again and cast off the other stops, the top will fall over the mast head, steadying over with the fore and aft guys, then lower away and place it into position on the trestle-trees.

Q. Do you know of any other way of getting the tops over the mast heads?

Ans. Put them on as the masts are being taken in. Have them ready, and as the head of the masts appears above the rail place them over the mast heads into position.

Q. Supposing you have put on the top as above, and hooked on your heel tackle, while you are wiping your tenon, &c., you see a strand of your purchase breaking, what would you do?

Ans. Rack the parts together directly and keep it so till I got a fresh purchase up.

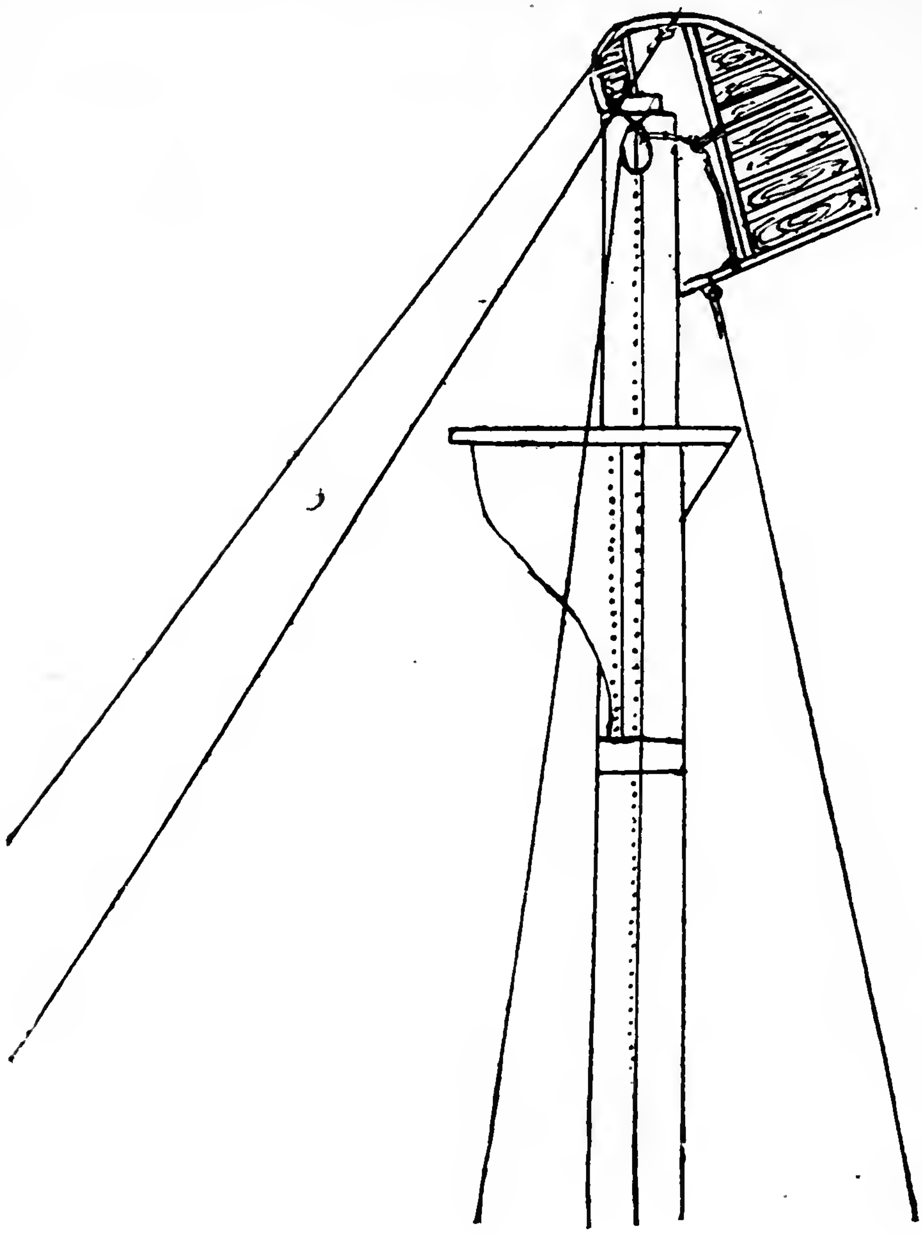
Q. What would you send up after the top?

Ans. The bolsters.

Q. And then?

Ans. Send up the lower cap into the top by one of the girtlines at the mast head. (See page 136.)

Fig. 53.



SENDING UP A TOP.

Q. What would you do next?

Ans. Shift the block to the after part of the trestle-tree for sending up the lower rigging.

Q. What part of the rigging would you send up first? **S.**

Ans. The fore swifters (five shrouds on each side); if six on each side there will be three pairs to starboard and port.

Q. Go on? **S.**

Ans. Then the starboard forward pair of shrouds, next the port forward pair, then the starboard second pair, and then the port. (Always rig to starboard first.)

Q. And next? **S.** Ans. The forestay.

Q. How would you send up a shroud? **S.**

Ans. Bend on the girtline with a timber hitch below the seizing of the eye, and stop it to the crown of the eye; sway up, and when high enough cast off the eye stop, and place over the mast head.

Q. Supposing your mast head were seven feet high, how far down from the crown of the eye would you bend on your girtline? **S.**

Ans. About 12 feet.

Q. What part of the rigging would you set up first? **S.**

Ans. The forestay. Alway stay the mast first.

Q. How would you turn in a dead eye? **S.**

Ans. With the lay of the rope. Some are spliced and some are turned in and seized.

Q. How would you reeve the lanyard, and why? **S.**

Ans. The hauling part of the lanyard under the standing part of the shroud, as it keeps the dead eye square and the strain on the standing part.

Q. What kind of knot would you make on the lanyard? **S.**

Ans. Either a single or double "Matthew Walker."

Q. Where should the knot be placed? **S.**

Ans. Underneath the end of the shroud.

Q. You are inboard, looking at a set of lower rigging being set up, where would the knot be? **S.**

Ans. With right-handed rigging, the knot would be aft on the port side and forward on the starboard side. It is always opposite to your left eye.

Q. How do you form the eye of the shroud? **S.**

Ans. Divide the shroud into three equal parts; the middle part will be for the eye; worm it with the lay, put it on the stretch, parcel it with the lay from each end to the centre, and serve it against the lay from the centre towards each end, and then seize it.

Q. How would you set up a shroud or backstay? **S.**

Ans. Luff upon luff; or with a tackle and runner. Fig. 54.

Note. Most modern ships have screw rigging, and consequently have no lanyards. The shroud or backstay is set up by simply turning the screw.

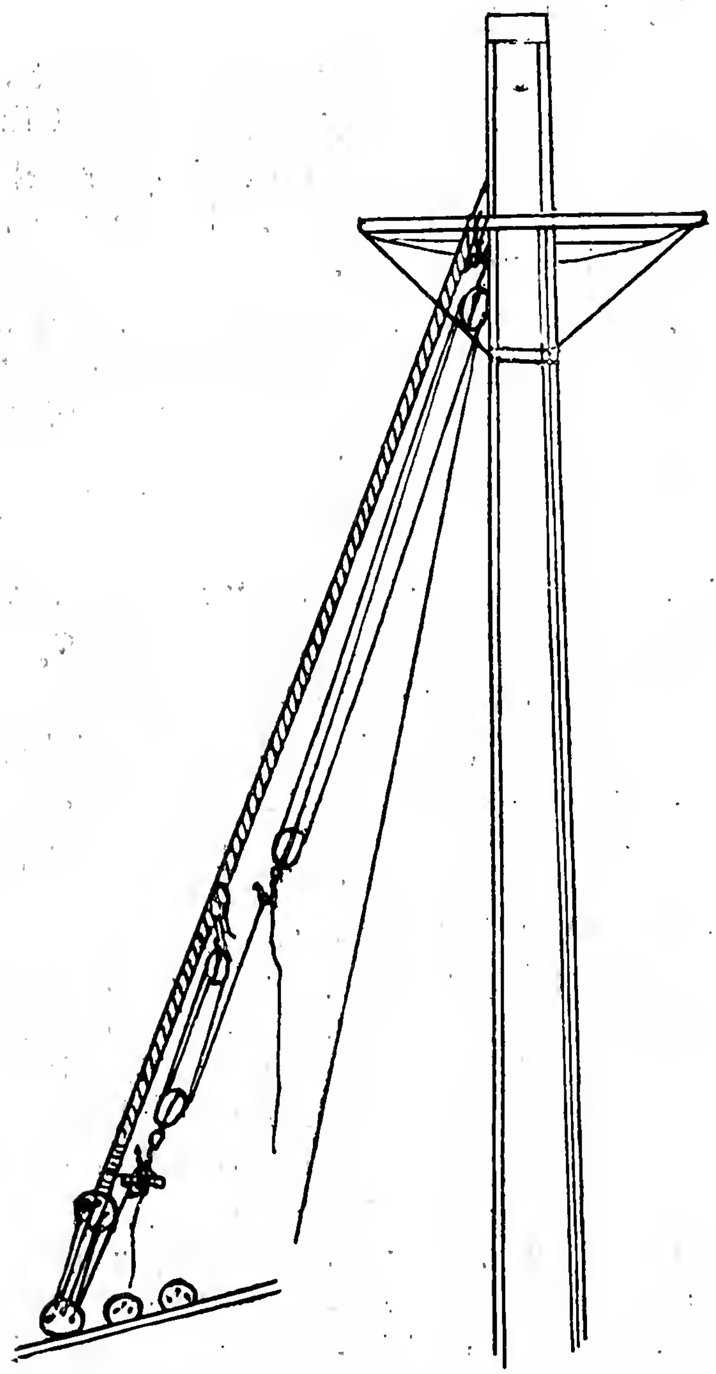
Q. Why do you parcel rigging upwards? **S.**

Ans. To shed the water; if parcelled downwards the water would lodge inside the parcelling.

Q. What allowance would you make for overlapping in the shrouds?

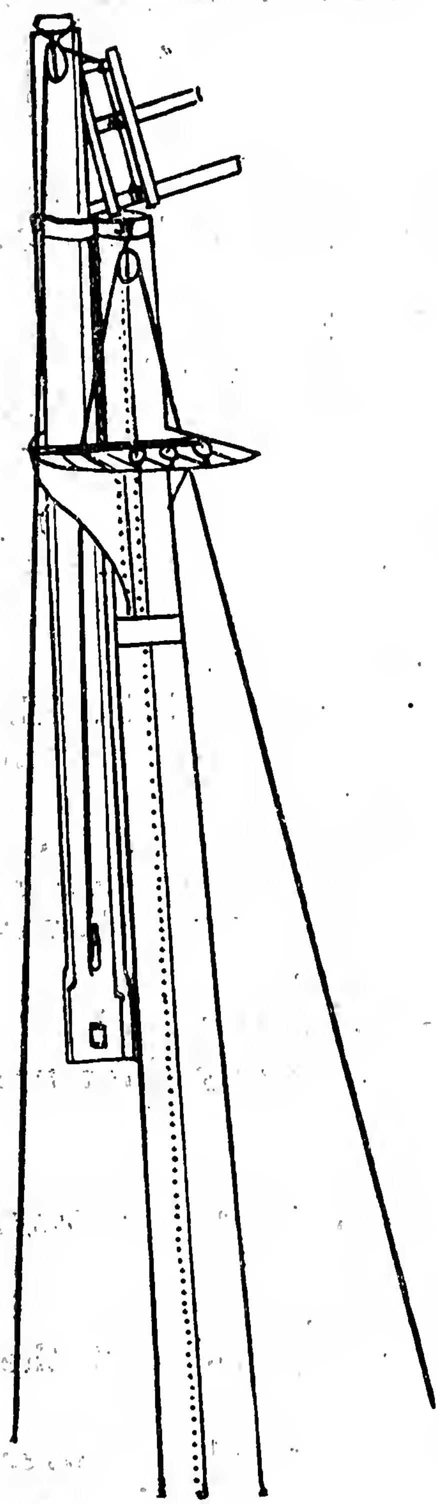
Ans. The breadth of a seizing larger than the one that precedes it.

Fig. 54.



SETTING SHROUDS UP.

Fig. 55.



SENDING TOP-MAST UP.

Q. Send the topmast up? S.*

Ans. Lay the topmast on the deck after side up and heel aft; hook a block to the eye-bolt at one side of the lower mast cap, and reeve the mast rope from aft, down through the square hole in the trestle-trees, along the top-mast and through the sheave hole in the heel of the mast; overhaul it along the mast towards the head and hitch it round the mast and the other part of the mast rope, leaving enough end for doubling; rack the two parts together below the hitch; sway away and point the head of the mast through the trestle-trees; double the mast rope by casting the hitch adrift and taking it up through the trestle-trees and making it fast at the other side of the lower mast cap; come up the racking, and sway away again until the mast head is a few feet above the cap, then lash girtline blocks to the top-mast head, reeving the girtlines from forward, overhauling them down to the deck; bend them to the after cross-tree legs and stop them to the fore; sway away until the cross-trees rests with the after part resting on the lower mast head, forepart against the top-mast, and the under side forward, lower the top-mast, cut the stops and the cross-trees will fall over the mast-head. If the top-gallant hole in the cross-trees is

* In sending up a steamship's topmast, there will be no cross-trees or bolsters to send up. When the topmast head is pointed through the lower cap, place over the gummet or funnel, next the starboard backstays, then the port backstays, and last the topmast stay. There may also be a jumper stay to put on after the topmast stay.

likely to fall over or jamb, lash a batten across. Heave away again until the cross-trees rest in their proper place.

Q. What will you do next?
Ans. Rig the top-mast.

Q. How?
Ans. First the bolsters, then the starboard rigging; next the port rigging, starboard backstays, port backstays, and the top-mast stay last.

Q. How does the top-mast stay lead?
Ans. Under the fore cross-tree legs and over the after. Some ships over both, resting on a cleat abaft the masthead.

Q. What would you do next? **S.**
Ans. Sway away and fid the mast, set up the top-mast stay, rigging and backstays.

Q. How would you send the lower cap up?
Ans. Send it up with the top-mast (see page 131). The cap having been previously hauled up on to the top and placed with the round hole over the square hole in the trestle-trees; when the top-mast is pointed through the trestle-trees, lash the cap to the mast-head, and when high enough slue the top-mast and place the cap over the lower-mast head, and beat it down into its place.

Q. How would you send the top-gallant mast up?
Ans. The same way as the top-mast, the only difference being in the rigging of it.

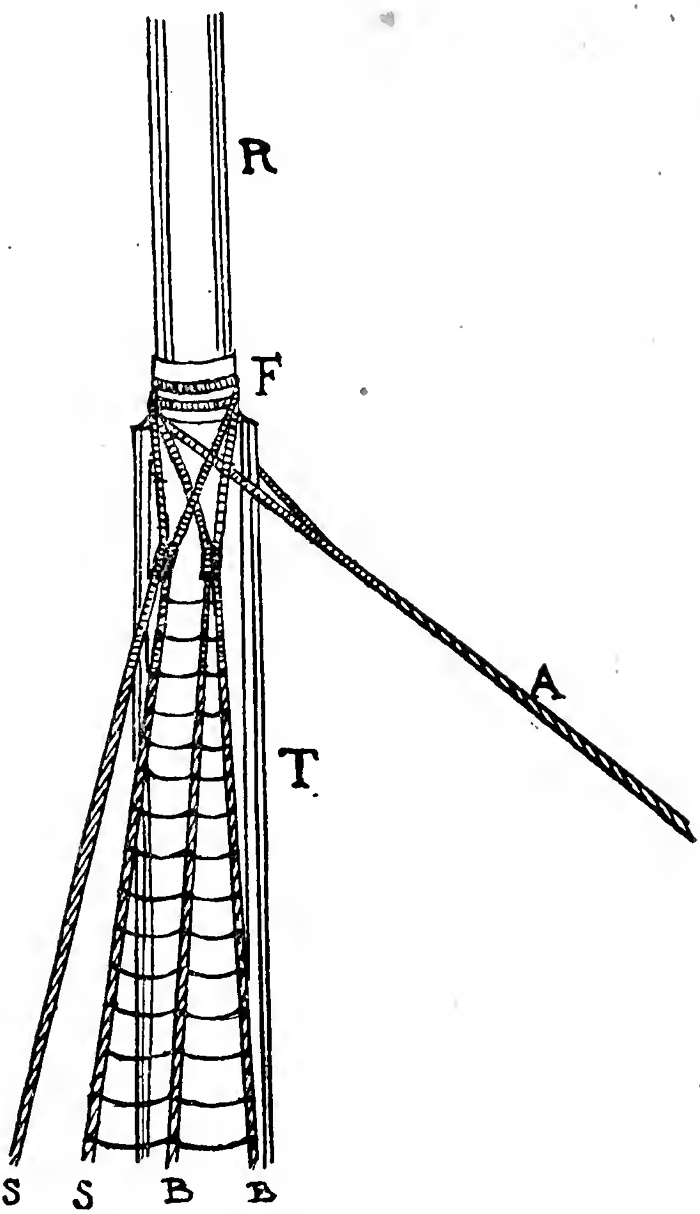
Q. How would you rig it?
Ans. First the grummet or funnel, then the stay, rigging and backstays.

Q. How would you rig the royal mast?
Ans. First the grummet, next the stay, and last the backstays.

Q. When do you put top-gallant and royal gear over the mast head?
Ans. Directly the mast is pointed through the top-mast cap.

Q. Which mast would you rig first? And why?
Ans. The fore-mast. Because I have the means of staying it; the main top-gallant mast, &c., cannot be stayed until after the fore-mast.

Fig. 56.



R Royal Mast.

T Top-gallant Mast.

F Funnel.

A Top-gallant Stay.

B Rigging.

S Backstays.

RIGGING TOP-GALLANT MAST.

Q. Send the top-mast down ?

Ans. Reeve the mast rope through a block at the lower-mast head, through the sheave-hole in the heel of the mast, and make it fast at the other side of the mast head, come up all the gear, (backstays, rigging, and topmast stay), sway a little to get the fid out, then lower away, surge quickly just before the cross-trees come on the lower-mast head, send down all the gear with girtlines, single the mast rope and lower the mast on deck.

Q. How would you send a top-gallant mast down ?

Ans. The same way as the top-mast.

Q. How would you send a jib-boom out ?

Ans. Reeve the heel rope through a block at the bowsprit cap, through the heel of the boom and make it fast at the other side of the cap; overhaul the fore and aft stays, back ropes and guys, make the flying-jib halyards fast at the end of the boom to keep it from dipping; heave away until the boom is far enough out. then down with the heel, clamp it, and lash a preventer round the heel of the boom and bowsprit.

Q. How would you get the heel down?
Ans. With a Spanish windlass.

Q. What would you do next?
Ans. Set up the back ropes, then the stays and guys.

Q. Send the jib-boom in?
Ans. Reeve the heel rope the usual way, and come up all gear,; make the flying jib halyards fast to the end of the boom; heave out a little to get the heel clear, then get a tackle on to the heel and heave the boom into its place; haul all the gear hand tight and frap along the boom.

Q. Send down a topgallant-yard blowing hard?
Ans. Unreeve the tie, reeve the yard-rope through the sheave-hole at the masthead, take a hitch round the lee quarter and make the end fast round the weather quarter of the yard, clear the yard of buntlines, clewlines, leech-lines, and the foot-ropes from the after side of the mast! lash a preventer parral round the yard and mast to keep the yard to the mast until ready for lowering away, sway away a little, unparral the yard, take the lifts off, top the yard and stop the yard-rope to the lee yard arm, lower away abaft all and to windward, sliding down the other part of the yard-rope or steadying the yard down with a tripping-line; take the braces off as the yard comes down.

Q. Send a topsail yard down blowing hard?
Ans. Send it down the same way as the topgallant-yard; if the yard is very heavy use a double purchase.

Q. Send up a topgallant-yard?
Ans. Reeve the yard-rope (abaft everything and to windward) through the sheeve hole at the mast-head, overhaul down to the deck and make fast about the middle of the yard, and stop it to what will become the lee yard arm. See all gear on the yard and heave away; when high enough shackle on the braces, heave away again towards the mast-head, cast off yard arm stop and put on the lifts, parral the yard, then let the yard take the lifts and haul.

tight the braces, after which the halyards and other gear will have to be rove.

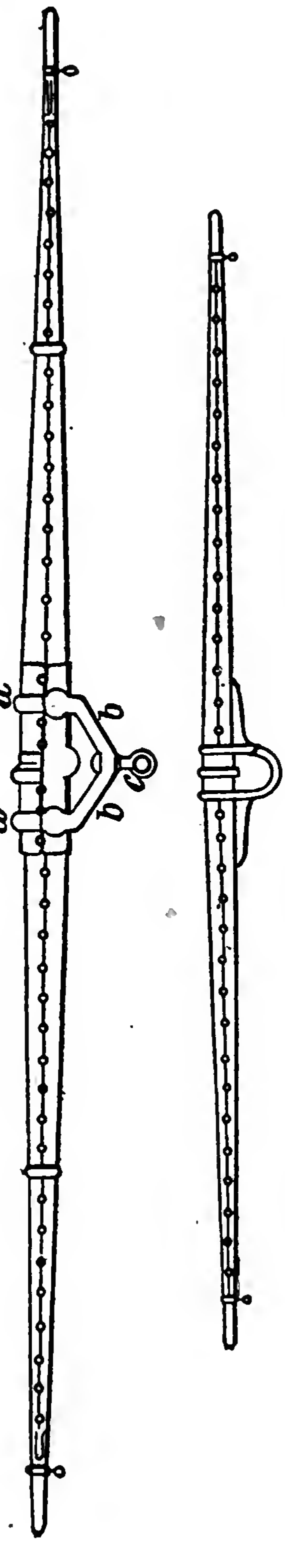


Fig. 57. LOWER AND UPPER YARDS.

a a Truss Hoop. *b b* Truss. *c* Swivel Bolt.

Q. Send up a top-sail yard ?

Ans. Similar to the top-gallant yard ; if the yard is heavy use a double purchase.

Q. Send up a main or fore yard ?

Ans. Lay the yard athwart the deck, resting on the bulwarks ; see all necessary gear on the yard including braces and foot ropes ; reeve a good purchase from the lowermast head, or better still—from the topmast head. Hook the lower purchase block to the middle of the yard and reeve a whip through a block at the fore side of the yard ; lead this whip well forward. Heave away on the purchase and keep the yard horizontal with the lifts or with a line on each yard arm ; when high enough, steady the yard into position with the lifts, braces and whip which is leading well forward. Shackle on the slings and truss the yard.

Q. How are topgallant and royal yards rigged ?

Ans. At the yard arms, iron hoops with eye bolts to hook or shackle the lifts, braces and footropes ; along the top of the yard a jackstay to bend the sail to ; at the middle of the yard —parral and eyebolt to shackle halyards to. There are also clewline blocks at the yard arms (some have them at the quarter of the yard) and on top of the yard, blocks or lizards for buntlines and leechlines.

Q. How are the other yards rigged ?

Ans. They all have the iron bands (or something equivalent) with the eyebolts, at the yard arms, to shackle the lifts,

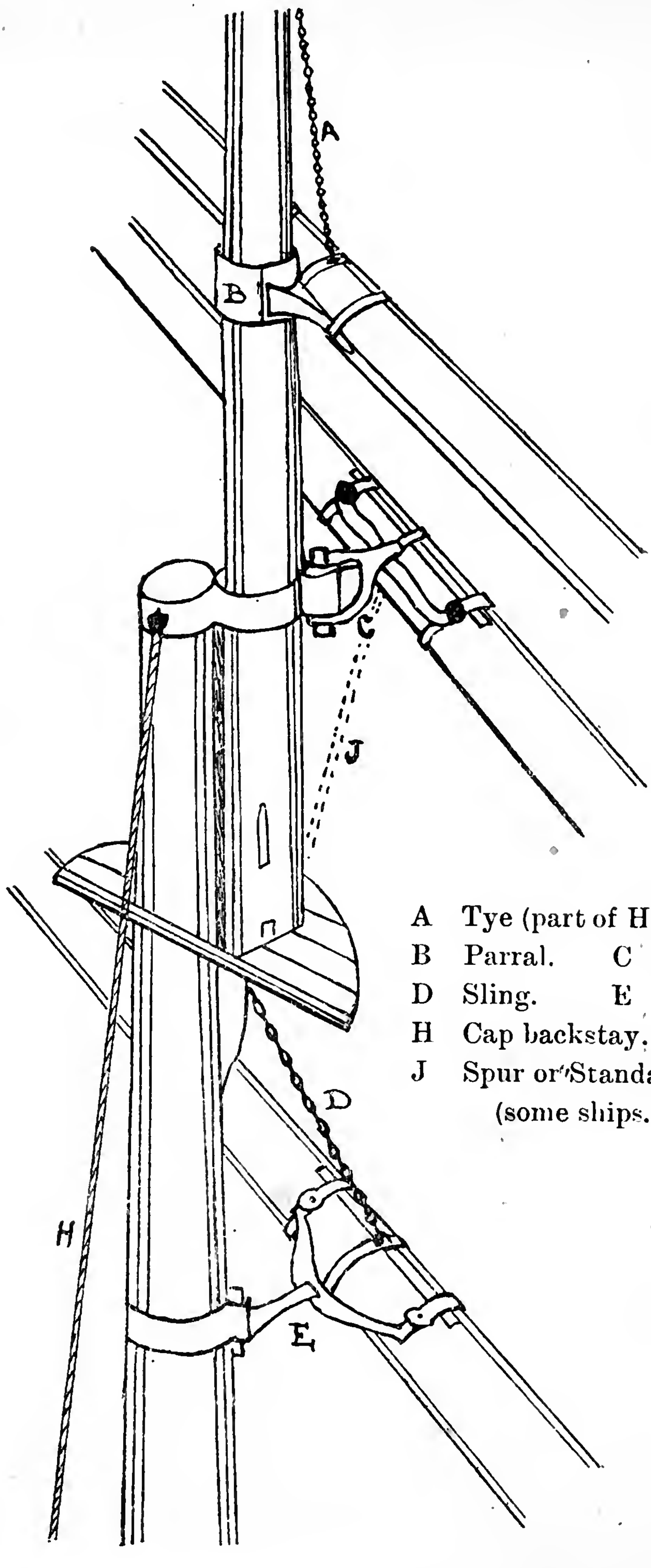


Fig. 58.

A Tye (part of Halyards)
B Parral. C Truss.
D Sling. E Truss.
H Cap backstay.
J Spur or Standard.
(some ships.)

braces and footropes, also the jackstay, clewline and buntline blocks or lizards.

The upper topsail yard is fitted with a parral, but the lower topgallant, lower topsail, and the fore main and cross jack yards are trussed.

Q. How are the lower yards supported ?
Ans. Slings, truss and lifts.

Q. Lower topsail yards ?
Ans. Truss. In addition to the truss, some lower topsail yards have an iron spur or standard J (Fig. 58) others have a crane. A lower topgallant yard is also supported by the truss.

Q. How are the other yards supported ?
Ans. By the lifts and halyards. All yards that hoist are fitted with a parral, lifts and halyards. The lifts and halyards take the weight when the yard is down, and the halyards when the yard is up.

MANAGEMENT OF A SHIP UNDER CANVAS.

(Note.)—A ship under close-reefed topsails is equivalent to a ship under lower topsails.

Q. The ship is under reefed topsails and courses with the wind a point abaft the beam and a heavy squall to windward, what would you do first ?
Ans. Haul the mainsail up, and keep her before the wind, then take the sail off her.

Q. Under reefed topsails, foresail, jib, foretopmast staysail, and main trysail, which would you take in first ?
Ans. The trysail.
Note.—Most ships now have staysails in the place of the trysail.

Q. How would you bend a foresail, blowing hard ?
Ans. Stretch the sail across the deck, bend on the buntlines, leechlines, and clewlines; reef the sail by the foot, tie stops right round the sail about every two feet, leaving the head outside; hook on the reef-tackles and stop the buntlines and leechlines to the head of the sail; then haul away on all the gear until the sail is snugly under the yard ; pass a few slack turns with the gaskets, make the midship stop fast, haul out the earings, tie the robands and stow or set the sail as required.
Note.—A mainsail and crossjack are bent the same way.

Q. How would you reef a topsail ?

Ans. Lower the yard, haul in the weather topsail brace, and check the lower yard ; haul out the reef tackles (if any), steady tight the halyards and lay aloft ; haul out the earings and tie the points, slack away the reef tackles, let go lee brace and hoist the yard, tending the weather brace as the yard goes up.

Q. Blowing hard the wind two points abaft the beam, you want to reef main and fore topsails, which topsail would you reef first ?

Ans. I should keep the ship before the wind, and reef the fore topsail first.

Q. At what time would you swing your main yard, staying a ship ?

Ans. With the wind about a point on the weather bow.

Q. What time the fore yard ?

Ans. When the mainyard is about full, and I think the fore yard will fill.

Q. Your are running with the wind three points on the starboard quarter, blowing hard, and it suddenly shifts round on the port quarter, what would you do ?

Ans. Hard a port, turn the after yards round and then the fore.

Q. If you were on the port tack, with the wind two points abaft the beam, and it suddenly shifts to four points on the starboard bow (caught aback on the lee bow), what would you do ?

Ans. Brail in the mizzen, square the after yards, and keep the fore yards aback to box her off ; when she pays off, haul the head yards round, and trim the sails.

Q. If you were close hauled on the starboard tack and caught aback right ahead, get the ship on the same tack ?

Ans. Hard up the helm ; flatten the head sheets ; box the fore yards and brail in the mizzen. If she fell off with the wind on the port bow, it would then be best to let her come round on her heel. (See last Question, page 146.)

Q. The wind increasing, how would you begin to reduce the sails in a full rigged ship ?

Ans. I would first take in the royals, flying jib, small staysails, and then topgallant sails.

Q. Go on—the wind still increasing?

Ans. I would reef each topsail.

Q. The wind still increasing, what would you do next?

Ans. I would close reef the fore and mizzen topsails, reef the courses, and stow the mizzen.

Q. Go on—the gale still increasing, with a strong sea running?

Ans. I would reduce to three lower topsails, reefed foresail, and fore topmast staysail, carry them as long as the ship and masts could bear them without injuring either, in order to keep steerage way on the ship. I would have the helm well attended to, easing it down to the pitching of the ship.

Q. If you have reduced to two lower topsails, and the ship will not carry them?

Ans. Stow the fore one, afterwards the main one, and set a storm trysail or staysail.

Q. The gale being at its height, and a very heavy sea running, the ship labouring very hard, could you do anything to ease her?

Ans. I would have the helm strictly attended to, and not lashed to leeward, as is often done. By carefully watching the action of the sea and motion of the ship she may be eased greatly when contending against a heavy sea.

Q. Is there anything you could do before the gale is at its height?

Ans. Send down royal and topgallant yards.

Q. Which is the best way to send them down?

Ans. I would send them all down to windward, bending a line on the lower yard arm to steady them while being lowered, or slide them down the yard rope.

Q. Suppose the storm staysail blew away?

Ans. Lash a tarpaulin in the mizzen rigging.

Q. Your rigging has become slack, what would you do?

Ans. Lash a spar outside the rigging on both sides, then pass a rope from one side to the other between each shroud, and bowse well tight.

Q. Suppose the vessel broke off, what would you do ?
Ans. Wear her.

Q. Why would you wear her ?
Ans. The vessel breaking off would bring the sea more on the beam, causing her to labour more heavily, and is often attended with great danger. The more a vessel can be kept end on to the sea, the easier she will bear its fury.

Q. How would you wear her with only the storm trysail set ?
Ans. If possible, I would set the lower fore topsail and staysail, take in the trysail, and put the helm hard up, ordering the crew from the deck till the vessel was before the wind. I would then brace round the after yards, clew up the fore topsail, lay the fore yards forward, but not sharp up, ready for stowing the sail, down fore topmast staysail, and as she draws the wind on the quarter, set the trysail or storm staysail again, keeping the crew as well sheltered as circumstances would permit until the ship comes to the wind, then stow fore topsail and staysail as quickly as possible.

Q. Why would you send the crew from the deck ?
Ans. In a heavy seaway there is great danger in a vessel going off, and likewise in coming to the wind; should a sea strike her at such times, it must always of necessity sweep something away, and no prudent officer will expose his crew more than is absolutely necessary.

Q. Weather moderating, what sails would you set first ?
Ans. I would set the three lower topsails, reefed foresail and foretopmast staysail.

Q. Go on setting the sails, the wind still moderating ?
Ans. I would set the three upper topsails, jib and lower staysails, mainsail and mizzen; then shake out all reefs and set the upper sails.

Note.—The square sails are usually "taken in" in the following order :—Mizzen royal, fore royal, main royal, mizzen topgallant-sail, fore topgallant-sail, main topgallant-sail, mizzen upper topsail, fore upper topsail, mainsail, main upper topsail, foresail, lower mizzen topsail, lower fore topsail and lower main topsail. The crossjack is usually taken in after the upper sails.

The same sails are generally set in the reverse order to taking them in.

Q. You are running with the wind on the starboard quarter, and it shifts suddenly round to the port beam with a hard squall, what would you do ?

Ans. I would haul in the starboard fore braces, and fill the head yards ; shiver the after yards, putting the helm hard a-port, brail in the mizzen, and let her go off before the wind until the sails were reduced sufficiently for the ship to bear them.

Q. Wind on the port quarter, the weather main top-gallant brace gives way and also the parral, what would you do ?

Ans. Masthead the yard and bring the wind on the starboard quarter so as to bring the yard gently aback against the mast. Then secure it.

Q. How would you haul the jib down ?

Ans. Keep the ship off a few points ; let go the halyards ; man the downhaul, easing off the sheet as the sail comes down.

Do not bring the ship to until the sail is stowed and the hands are off the boom.

Q. How would you reef a course ?

Ans. Hook a reef pennant on to weather clew and haul tight the lifts, haul the sail up the same as for stowing (not right up), then haul out the reef-tackles, lay aloft, haul out the earings and tie the points ; then slack away the reef tackles and set the sail.

Q. You are nearing your port of destination (by your reckoning) in foggy weather, when would you bring your ship to an anchor ?

Ans. When I found by the lead that the water shallowed to a prudent depth.

Q. How would you put your ship about ?

Ans. Give the order, "*About Ship.*" See all clear, the hands at their respective stations, ease the helm down and haul the mizzen boom amidships. "*Helm's a-lee*" ; then as she comes to and shakes, "*Tacks and sheets*" ; and when within one point of the wind, "*Mainsail haul*" ; down main tack and aft sheet ; trim the head sheets and shift the helm, if necessary ; when round far enough for the head yards to fill, "*Let go and haul*" down tack and aft sheet, brace the yards and haul out the bowlines. (See 3rd and 4th Questions, page 142.)

PUTTING SHIP ABOUT.

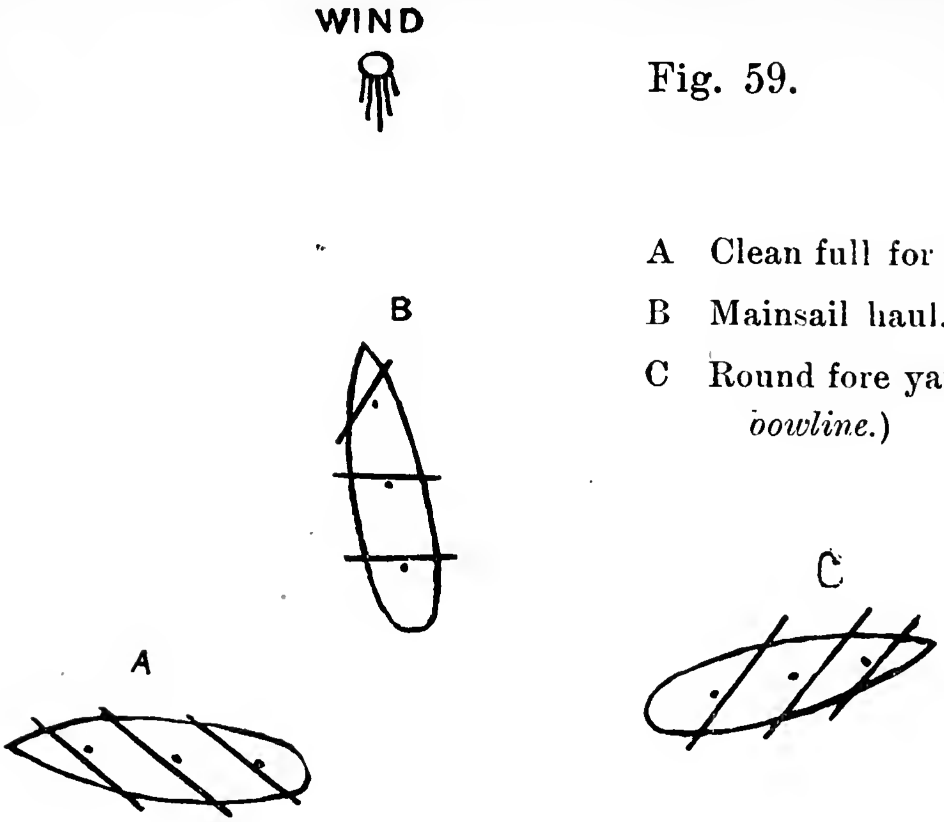


Fig. 59.

A Clean full for stays.

B Mainsail haul.

C Round fore yard (*fore bowline.*)

Q. How would you tack a lazy ship?

Ans. Keep her clean full for stays; when the sails shake, ease the lee fore brace to back the fore yards suddenly, and haul the mizzen boom amidships.

Q. How would you put the ship about with only the watch?

Ans. I would hook my tack tackles on the lee side ready for boarding the tacks when round, raise the clews of my courses, and then proceed as with all hands.

Q. In staying what is to be particularly noticed?

Ans. If the ship gathers sternway, to shift the helm.

Q. In staying, suppose your ship paid right off before the wind, how would you act?

Ans. I would keep the fore yard square until she came to, then trim it.

Q. Suppose your ship missed stays, what would you do? Ans. Let her come round on her heel?

Q. How would you do it?

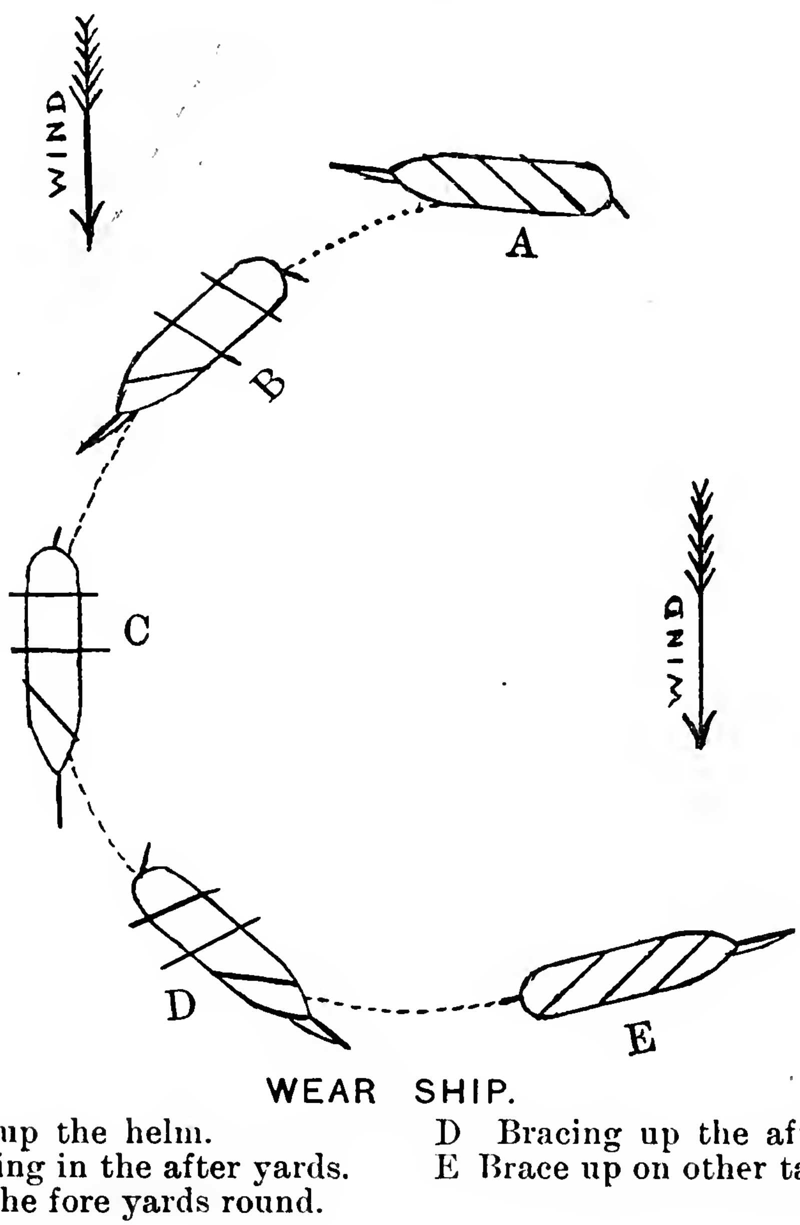
Ans. As the ship will have stern away, I would shift the helm a-lee again, square the after yards, haul the head sheets aft and brail in the mizzen. When she gathers headway I would shift the helm a-weather and shiver the after yards; when before the wind square the fore yards, and when she gets the wind on the other quarter, haul out the mizzen and brace the yards up as the ship comes to. (See box-hauling further on, in Masters' questions.)

Q. How would you wear a ship with ordinary canvas set, all light sails in?

Ans. Brail in the mizzen, hard up the helm, and as she goes off, square in the after yards, keeping them just on the shake; when before the wind, square the fore yards and brace them up for the other tack; then as the ship is coming to, brace up the after yards and set the mizzen.

Note.—If there is not much sea, brace the after yards round for the other tack when before the wind, and the fore yards as she comes to the wind.

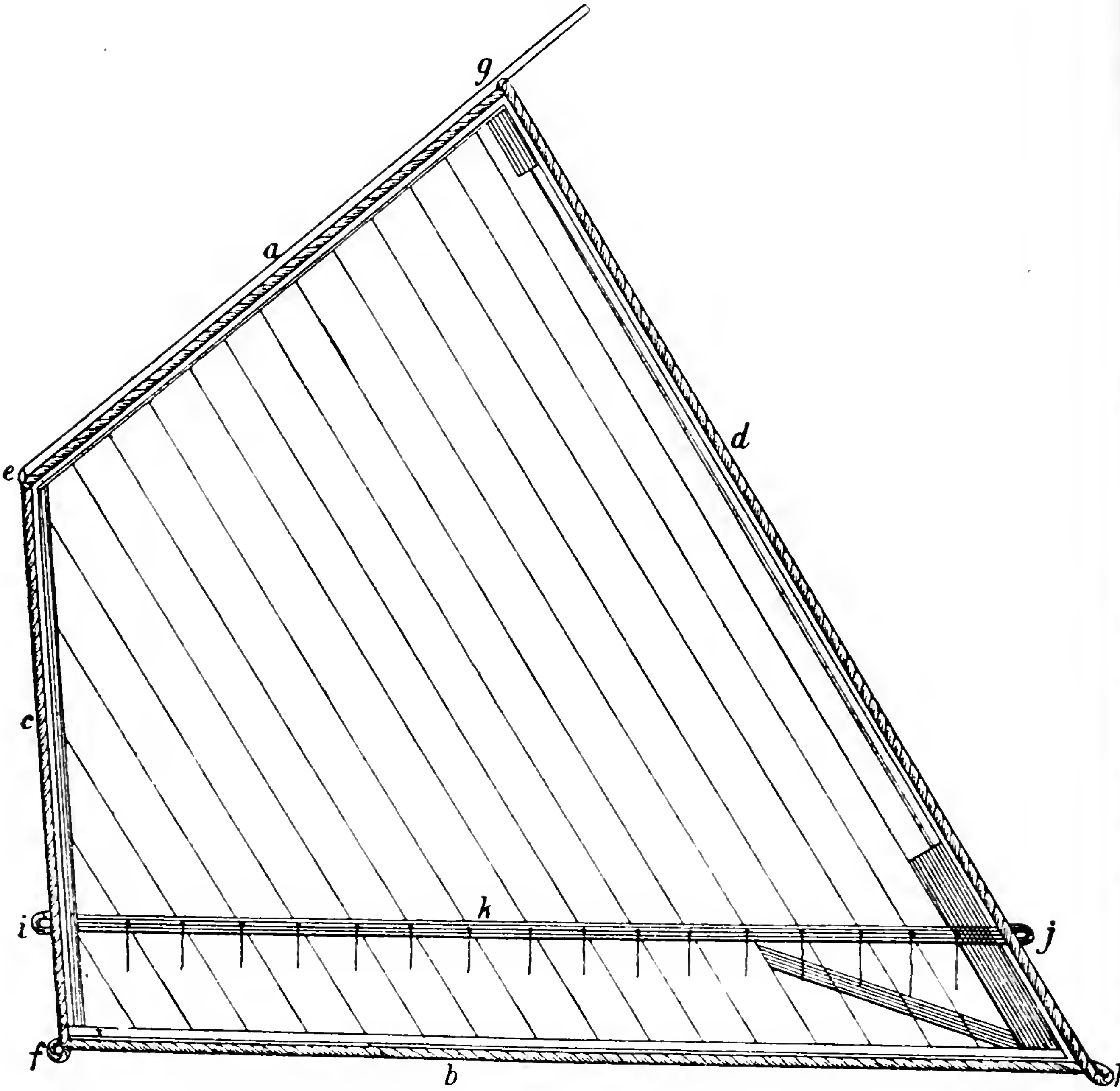
Fig. 60.



WEAR SHIP.

A Hard up the helm.
B Squaring in the after yards.
C Haul the fore yards round.
D Bracing up the after yards.
E Brace up on other tack.

TRYSAIL OR MIZZEN.



a Head-rope. *d* After leech rope. *h* Clew.
b Foot-rope. *e* Throat. *i* & *j* Reef cringles.
c Forleech or luff. *f* Tack. *g* Peak. *k* Reef-band.
e, *f*, *g*, *h*, *i* & *j* are cringles with thimbles in them.

Fig. 61.

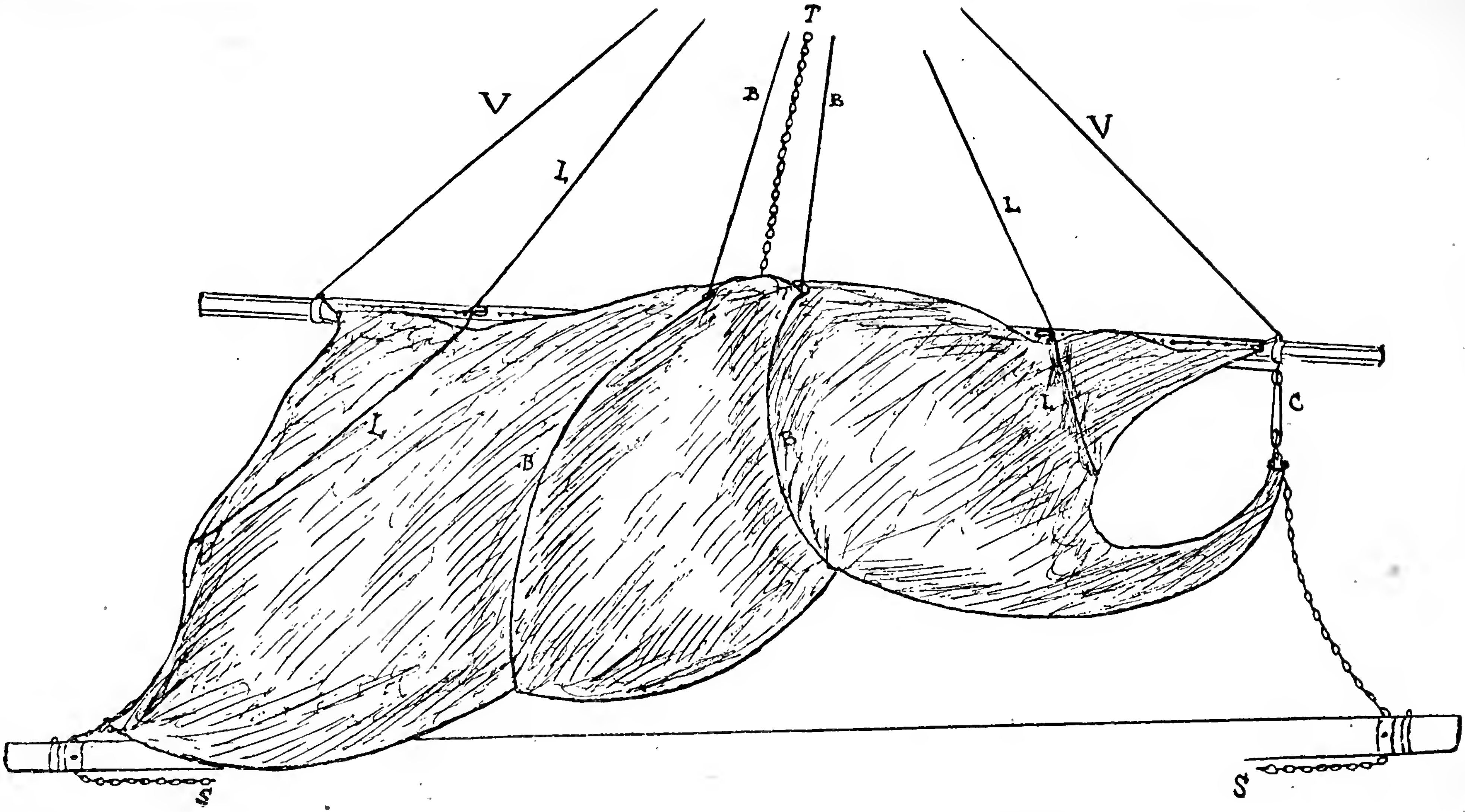
Q. How would you take a topgallant sail in ?

Ans. Clew down the yard, check the weather brace, haul up the lee clew line, buntline, and leechline, then the weather gear and stow the sail.

The royal is taken in in a similar way.

Fig. 62.

TAKING IN A TOPGALLANT SAIL.



B	Buntlines.	C	Clewlines.	L	Leechlines.
S	Sheets.	T	Tie,	V	Lifts.

Q. How would you set it?

Ans. Loose the sail, overhaul the gear, haul home the lee sheet, then the weather sheet, hoist the yard, tending the weather brace, then haul tight the lee brace.

Set the royal the same way.

Q. How would you take in the mainsail in a gale of wind?

Ans. Keep the ship well full; steady the lifts; ease off the lee sheet a fathom or so; man the weather clew-garnet, buntlines and leechlines; then ease away the tack and haul upon the clew-garnet and buntlines; the tack being close up, man the lee clew-garnet, buntlines, and leechlines; ease away the sheet and haul upon the clew-garnet, buntlines and leechlines. This sail, as well as the foresail, is often taken in by means of spilling lines.

N.B.—Some prefer the lee sheet hauled up first; but it shakes the sail more, consequently is more liable to carry the sail away.

Q. How would you set a course?

Ans. Loose the sail, overhaul all gear, let go lifts, haul aft the slack of the sheet, down with the tack, and haul the sheet flat aft.

Q. How would you set an upper topsail or upper topgallant sail?

Ans. Loose the sail, let go downhauls, also the sheets of the sail above, overhaul gear and hoist away on the halyards, tending the weather brace.

Q. How would you take them in?

Ans. Lower away, haul on downhauls, take in slack of weather brace, haul on the buntlines or the spilling lines; steady tight the halyards and braces, placing the yard parallel with the lower yard, then stow the sail.

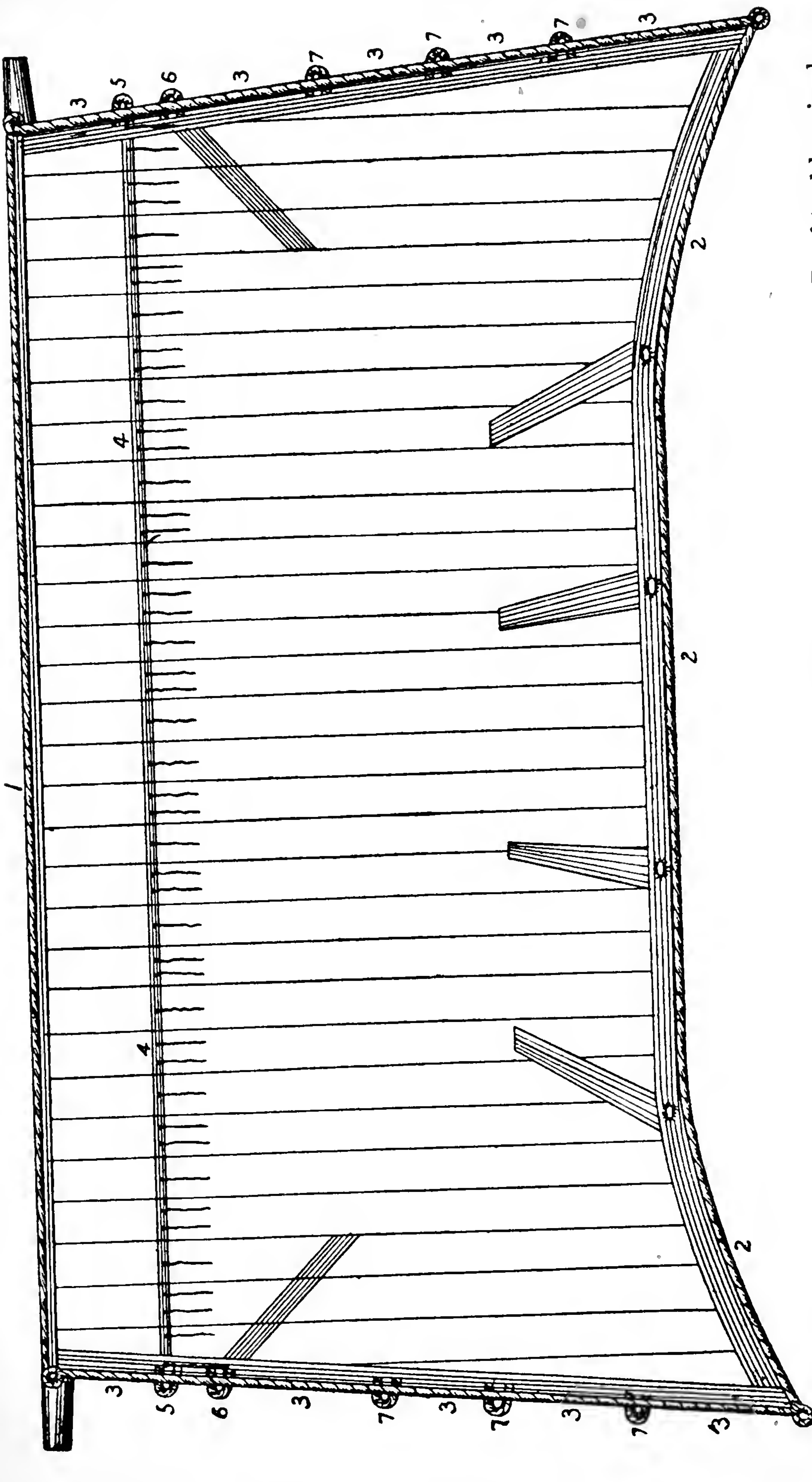
Note.—It is not usual to clew these sails up as the sheets are kept fast at all times. Some have no sheets, the clews being shackled to the lower yard arms.

Q. Take in the mizzen?

Ans. Ease off the weather vang and boom sheet, haul down the head, slack away the foot outhaul and haul on the lee brails, taking in the slack of the weather brails.

Fig. 63.

COURSE.



1 Head-rope. 2 Foot-rope. 3 Leech-rope. 4 Reef-band. 5 Reef cringles. 6 Reef tackle cringles.
7 Leech-line & Bowline cringles. The upper corners are Earing-cringles & the lower corners Clew-spectacles.

Q. Set the mizzen?

Ans. Ease off the weather vang and boom sheet, let go the brails, haul on the foot outhaul, then haul on the head outhaul and when the head is full out, give another pull on foot outhaul and trim the sail.

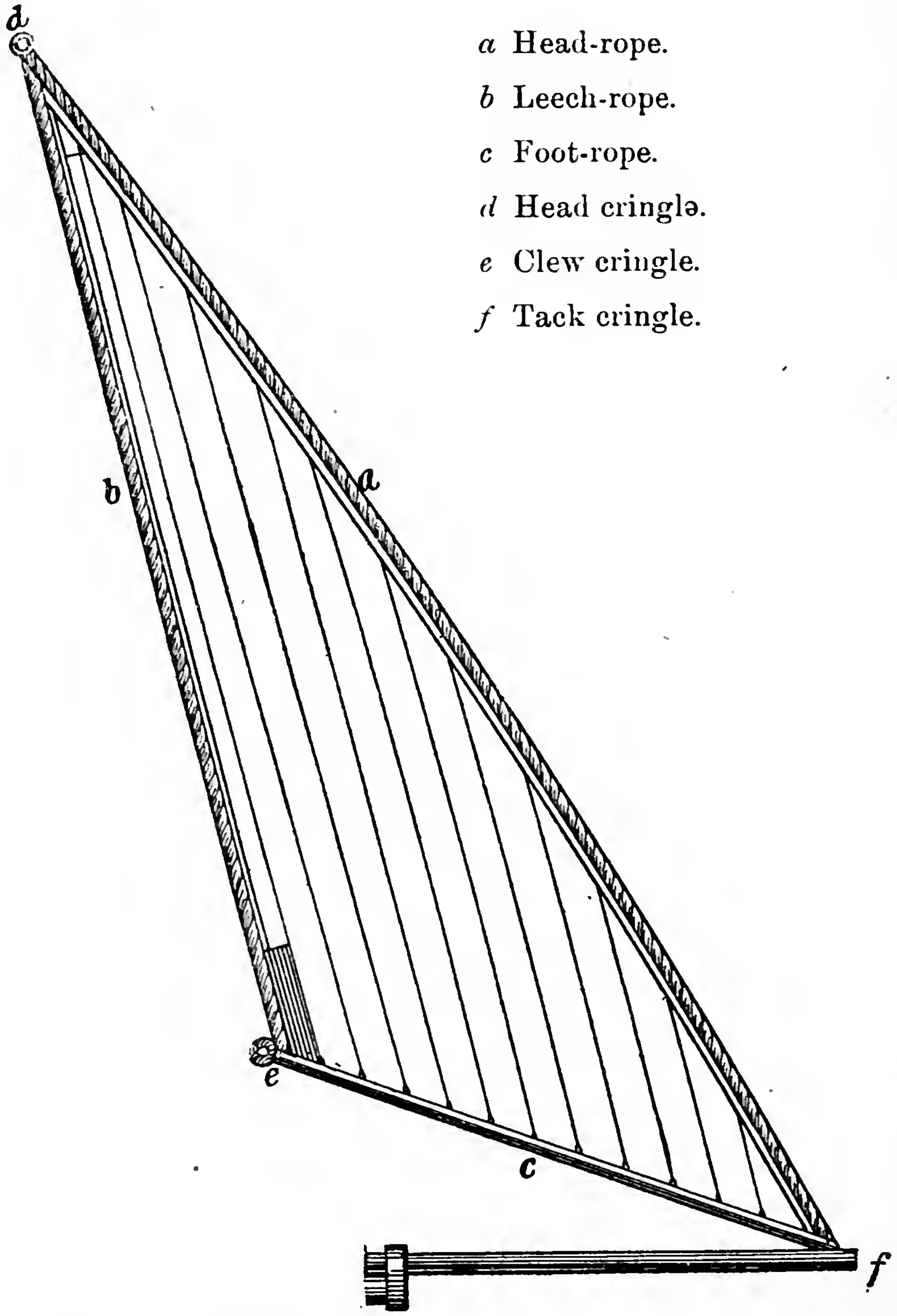


Fig. 64. JIB.

Q. Set the jib?

Ans. Loose the sail, haul aft sheet, let go down haul and hoist away on the halyards, tending the sheet, and when set, trim the sail.

Q. How would you shake out a reef?

Ans. Haul the reef tackles well tight. Ease the tack and sheet of a course; settle the halyards and haul tight the downhauls for a topsail. Each man must commence at the middle of the yard, loosing the points, working outwards towards the yard arms. The earings are eased off together, reef tackles let go and the sail set the usual way.

Q. What would you do after unbending sails?

Ans. See them tallied and repaired before stowing them in the locker.

Q. You have to cut masts away, which side would you cut first?

Ans. Lee side; the masts will then go clear, and not be fastened to the ship.

QUESTIONS RELATING TO STEAMSHIPS.

Q. A steamship moored alongside quay or wharf, what precautions would you adopt?

Ans. Have fenders over the side to prevent chafe. Have a bow and quarter spring to the shore to secure her.

Q. In getting under weigh, what should be seen to before the engines are started?

Ans. Have a report from the engine room that everything is clear about the engines; see that there is nothing foul of the propeller; be very careful to haul in the slack of the quarter rope as it is eased off, for fear of the bight fouling the screw; and see that the wheel chains, leads and rudder are in perfect working order.

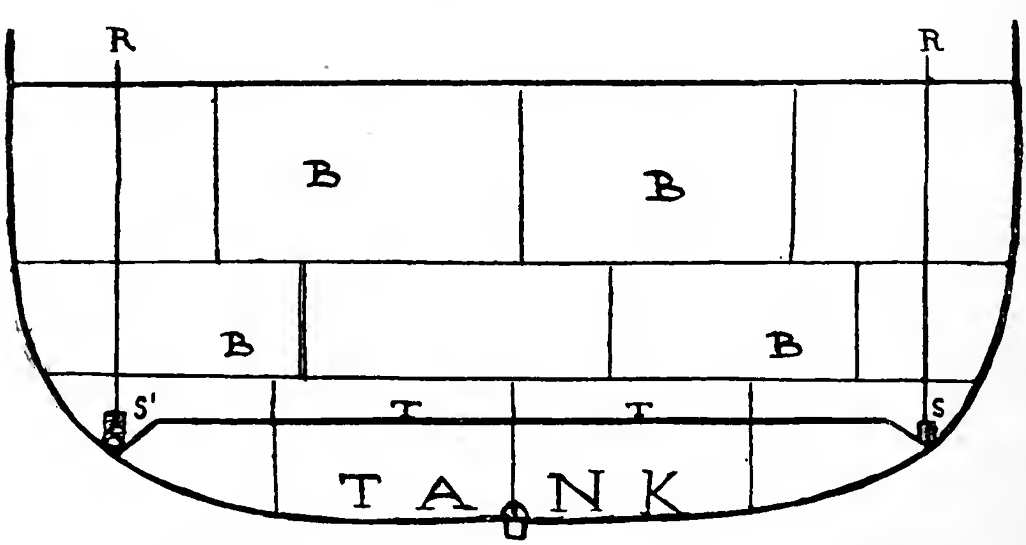
Q. Describe any arrangement of limbers you know of?

Ans. The water-ballast tank is made flat on its top till it approaches the sides, when it is made to curve down, thus forming a deep gutter at each side, running fore and aft. Many modern steamships have no limbers in the bilges, the tank top going straight out to the side of the vessel, and provision is made for water in the hold to drain into a well between two solid floors under the tank top.

Q. What are they for?

Ans. To allow water to find its way to engine room bilges, where it can be pumped out.

SLUICES.



R Sluice Rod. S^1 Sluice open. B Bulkhead.
T Tank Top. S Sluice closed.

Fig. 65.

Q. How can it pass the bulkheads?

Ans. There are sliding doors (called sluice valves) worked from the deck, which, on being opened, allow the water to pass through on its way to the pumps.

(Modern ships in lieu of sluices, have pipes with strum boxes at the ends, leading from each hold direct to the engine room.)

Q. How often do you open sluices?

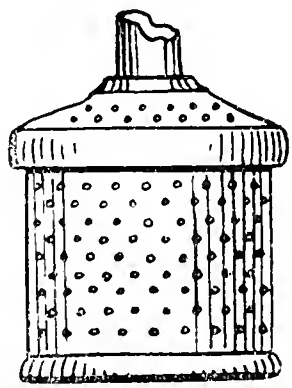
Ans. Every day.

Q. What are strums?

Ans. Perforated boxes to keep any dirt from getting to the pumps.

Strum boxes are now mostly square instead of round.

Fig. 66.



STRUM BOX.

Q. How do you clean out the limbers?

Ans. By hand when possible. If the hand will not reach, then by a tin fastened to a rod. The limbers should be limed or white-washed after cleaning.

Q. What are the advantages of water-ballast tanks?

Ans. A ship when being moved from one port to another in ballast saves the expense of buying and loading ordinary ballast, the expense of discharging it, and the loss through detention in both operations; because she opens her water ballast cocks and allows the water to run in as she goes along; and as she is reaching her port she begins to discharge it through her donkey ballast pump. They should be always full, if not she is liable to list.

Q. Describe an engine room telegraph?

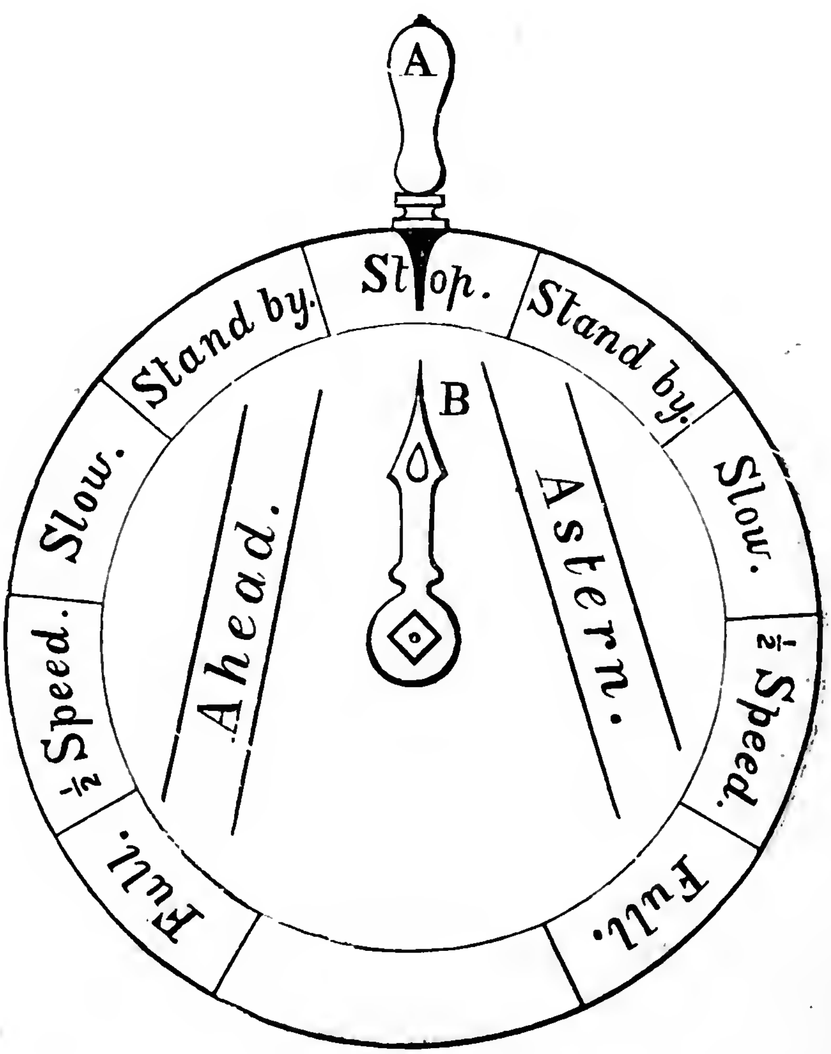
Ans. In the following sketch the handle A is worked by the officer of the watch, who moves it towards his left side for going ahead, and toward his right hand for going astern. The vertical position is "stop," and the other orders are "stand by," "slow," "half speed," and "full."

The pointer B is the repeating signal, and is worked from the engine room thus :—The officer on deck puts the handle A at "$\frac{1}{2}$ speed" to the left ; this motion causes a bell to ring in the engine room ; upon this the engineer looks at his dial and sees the pointer at "$\frac{1}{2}$ speed," he then moves his handle to the same, and this movement causes B to move round to "$\frac{1}{2}$ speed" ahead, thus showing the officer of the watch that his order is perfectly understood.

Q. Prepare a steamship for sea ?

Ans. See that there are no warps foul of the propeller ; everything securely lashed and hatches properly battened down ; no iron near the binnacles ; steam whistle all right ; telegraph all right ; try the steam steering gear over each way ; see that the hand gear is ready for shipping ; and

Fig. 67.



that the wheel chains are clear ; log and lead line ready ; all lights trimmed, and the water drained out of the cylinders of the winches.

Q. How do you drive a winch ?

Ans. Open the drain cocks ; stand with one hand on the throttle valve, the other hand on the reversing lever, and a foot near the brake.

Q. You have charge of the deck of a steamer at sea, and a cry is raised of a man overboard on the port bow ; what is the first order you would give, and why ?

Ans. Starboard. To give the man a chance of clearing the screw.

Q. Making land in a dense fog ?

Ans. Have the ship eased down to *slow* ; keep the lead going and double the look-out.

Q. Repair link in wheel chain ?

Ans. Ship the hand gear, and repair with a connecting link.

Q. One of the steering rods is broken ?

Ans. Ship the hand gear, and repair with a spare rod, or a length of chain or wire.

Q. The steam pipes on deck are frozen ?

Ans. Build fires round them, or place hot fire bars at each side.

Q. What flag does a pilot boat fly while on pilotage duty ?

Ans. White and red (horizontal).

Q. Where is the register tonnage and official number usually marked in a steamship ?

Ans. On the after coaming of No. 2 hatch.

Q. How must a lifeboat be equipped ?

Ans. A full complement of oars aud two spare ones ; two plugs for each plug hole, attached with lanyards ; one set and a half of thole pins or crutches, attached with lanyards ; sea anchor, baler, rudder and tiller or yoke lines, painter, boat hook, vessel kept filled with fresh water, two hatchets attached with lanyards (one at each end), mast and sail, life line round the outside of boat, efficient compass, one gallon of vegetable oil, and a vessel for distributing it, a lantern trimmed with oil to burn 8 hours, an air tight case containing 2 lbs. of biscuits for each person, one dozen self-igniting red lights in a water-tight tin, and a box of matches in a water-tight tin.

Q. What would you have ready going alongside quay ?
Ans. Warps, fenders and heaving lines.

Q. What would you do if you had to leave a ship on fire ?
Ans. Provision the boats and stand by; the flames should attract the attention of other ships. If you have to leave because of the ship foundering, make for the nearest port or track of ships.

Q. Opening fore peak hatch after an interval of weeks, what would you do ?
Ans. Have the peak well ventilated before sending any hands down, and do not allow any naked lights as there might be danger of explosion from gases.

Q. What is often stowed in fore peaks that will cause explosions ? Ans. Patent paints.

Q. How can you tell when the ballast tanks are full ?
Ans. When filling ballast tanks, the caps are unscrewed from the sounding pipes to allow the air in the ballast tank to escape. When the tank is nearly full, water is forced up the sounding pipe several feet above the deck, and when the tank is completely full and all the air forced out, the column of water above the deck subsides and runs over on to the deck.

Q. What precaution will you take when filling up water ballast tanks ?
Ans. See the caps taken off the sounding pipes to allow the air in the tank to escape.

Q. You are nearly loaded, what would you see to regarding ballast tanks ?
Ans. Sound all of them, to make sure that there is no water left in any of them, and screw the caps on to the sounding pipes.

Q. How often is it advisable to have boat drill ?
Ans. Every week, and see that the same men always go to the same boat.

Q. How will you give the man at the wheel his course, when setting the course by the standard compass ?
Ans. Steady the ship's head on the course by standard

compass, then notify the steersman to steer the course he sees on the wheel compass.

Q. You are painting a peak with patent paint, what will you be careful about?
Ans. Have the peak well ventilated and keep a constant watch on the men below.

Q. What are the usual lengths of cargo falls?
Ans. Between 15 and 26 fathoms, according to length of derrick and depth of hold.

Q. How would you pass a drift net fishing vessel?
Ans. Pass under the end having the high light.

Q. When is a submarine subject to the rule of the road?
Ans. When the upper part of her hull is visible.

Q. Where is a ship to be marked so as to show her draught?
Ans. On her stem and on her stern post in Roman capitals, or figures six inches in length.

Q. How do you measure the draught of a vessel?
Ans. To the lower edge of the figure; the upper edge is the half foot.

Q. What do you mean by a clear side?
Ans. The distance from the water line to the upper deck; the deck line is marked on the ship's side.

THE SCREW RACE.

Q. What is meant by a right-handed screw propeller?
Ans. One that revolves from the port to the starboard side of the ship during the upper part of its revolution while the ship is moving ahead, and the propeller is being looked at from aft, forward.

Q. What is meant by a left-handed screw?
Ans. One that revolves from the starboard side to the port side under the same condition as in the last.

Q. What effect has a right-handed screw on a ship going ahead?
Ans. It tends to send her to the port side of her course, the effect being as if she carried a starboard helm.

Q. What effect has a right-handed screw upon a ship going astern?
Ans. To throw her to starboard of her course.

Q. What effect has a left-handed screw upon a ship going ahead ?

Ans. To throw her to starboard of her course.

Q. What effect has a left-handed screw upon a ship going astern ?

Ans. To throw her to port of her course.

Q. How would you turn a steamship short round with a right-handed propeller ?

Ans. Hard a port and give her a few turns ahead ; when far enough ahead, stop her, and come astern ; when she gathers stern away, shift her helm ; when far enough astern go ahead again and so on till she is round.

Note.—The helm cants the ship going ahead, and the propeller when coming astern. In this case the ship's head is canting to starboard when going ahead and astern.

Q. There is not sufficient room to go ahead and astern ?

Ans. Drop the anchor and steam round it with the helm hard over, paying out just sufficient cable for the anchor to hold.

Q. There it not sufficient room to steam round the anchor ?

Ans. Place her bow against the bank or quay and heave her round ; the wind or tide might be favourable to swing her round.

Q. How would you turn a steamship short round with twin screws ?

Ans. Ahead on the port screw and astern on the starboard will cant the ship's head to starboard.

Ahead on the starboard screw and astern on the port will cant the ship's head to port.

Going ahead with both screws, she should go straight.

Q. Which end of a ship does the rudder move ?

Ans. The stern ; when the helm is put over to starboard, the stern goes to port, and when put over to port, the stern moves to starboard.

Q. What is the *pitch* of a propeller ?

Ans. The distance it moves forward in one revolution, providing there is no slip.

Q. What is the *slip* of a propeller ?

Ans. The difference between the speed of the ship and the speed of the propeller.

Q. What is meant by the *speed* of the propeller ?

Ans. The rate it would move forward, if there was no slip.

Q. Where does the ship first receive the driving force or thrust from the propeller ?

Ans. On the thrust block.

Q. What is a *thrust block* ?

Ans. A block through which passes the thrust shaft, transmitting the force caused by the thrust of the propeller to the block, thus relieving the crank-shaft from the strain. It is secured to a base plate immediately abaft the engine room.

VENTILATION.

Q. What general direction does the air between decks take ?

Ans. It takes the opposite direction to that of the wind when the lee ventilator is the downtake. The more the ship is battened down the more sure is this rule.

Q. How would you trim ventilators ?

Ans. Lee one, mouth to wind (downtake); weather one back to wind (uptake). Some prefer them trimmed the opposite way, the air between decks would then travel in the same direction as the wind.

Where should ventilators be put ?

Ans. There should be two at least, one forward and one aft, for each hold.

Q. Are the ventilators protected ?

Ans. Yes, with cowls.

Q. Under what conditions are coal cargoes most dangerous, that is, most liable to spontaneous combustion ?

Ans. When the coal is subject to breakage during transport from ship to ship, when coal which is bituminous is shipped in a wet condition; and especially when the ventilation is through the body of the coal cargo.

Q. In fine weather what would you do with such a cargo ?

Ans. Keep the hatches off, wherever possible.

Q. What precaution should always be adopted with coal cargoes during long voyages ?

Ans. The temperatures of the various portions of the cargo should be tested periodically by thermometers and registered in the log.

Q. Besides the hatches, what other means must be adopted for relieving the gases from the surface ?

Ans. There must be ventilators giving *free* and *continuous* egress to the open air in all states of the weather.

Q. In ventilating the 'tween decks of an emigrant ship, what is most to be guarded against ?

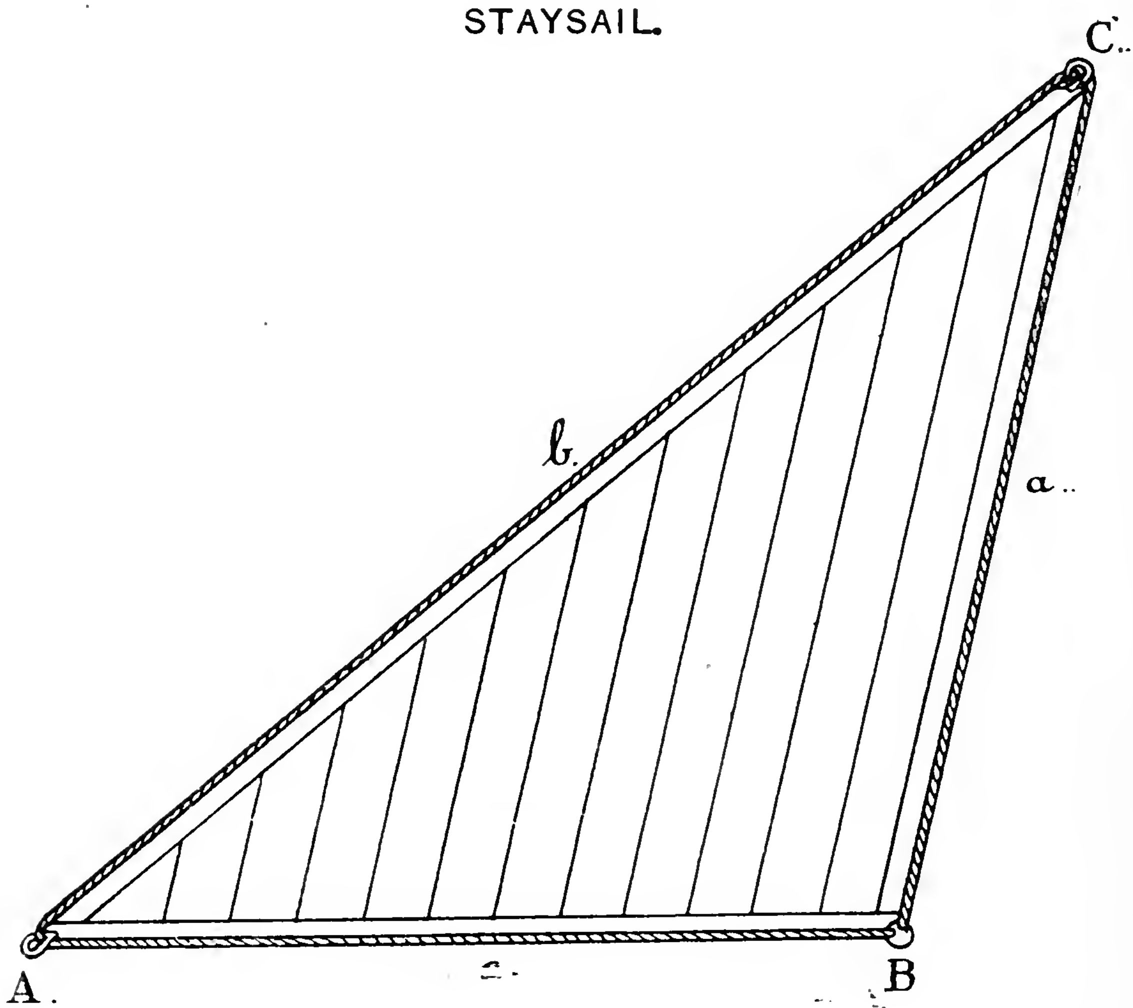
Ans. The down draught, giving cold to the passengers.

STEAMSHIP SAILS.

Q. Name the parts of a staysail ?

Ans. Luff on fore leech, after leech, foot, tack, head and clew. (Fig. 68).

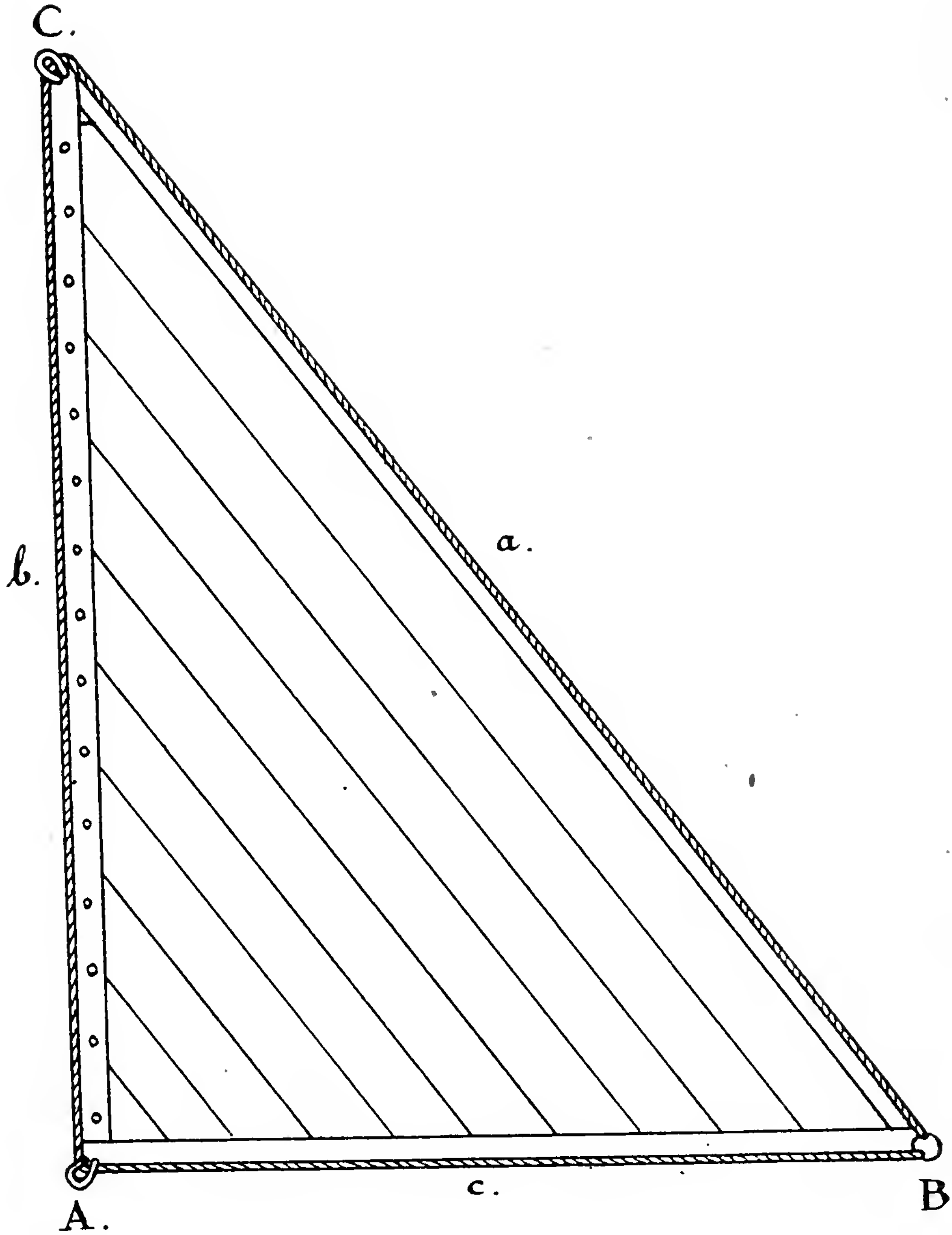
STAYSAIL.



A	Tack.	*a*	After Leech.
B	Clew.	*b*	Fore Leech or Luff.
C	Head.	*c*	Foot.

Fig. 68.

STEAMSHIP'S TRYSAIL.



A	Tack.	*a*	After Leech.
B	Clew.	*b*	Fore Leech or Luff.
C	Head.	*c*	Foot.

Fig. 69.

Q. What gear is there on a staysail?

Ans. Halyards, downhaul and sheet.

Q. Set a staysail?

Ans. Loose the sail, haul aft the sheet, let go downhaul, and hoist away on the halyards. Ease the sheet as the sail goes up, and when the sail is right up haul on the sheet and trim it.

Q. Haul down or take in a staysail?

Ans. Let go halyards, man the downhaul, and ease the sheet as the sail comes down.

Q. What does a staysail travel on?

Ans. On the stay; there are hanks on the stay which are seized to eyelet holes on the luff or fore leech.

Q. Name the parts of a trysail?

Ans. Luff or fore leech, after leech, foot, tack, head and clew. (Fig. 69).

Q. What gear is there on a trysail?

Ans. Halyards, downhaul and sheet.

Q. Set a trysail?

Ans. Loose the sail, haul aft the sheet, let go downhaul, and hoist away on the halyards, tending the sheet as the sail goes up by slacking and then hauling in when sail is set.

Q. Take in a trysail?

Ans. Man the downhaul, let go halyards and ease the sheet as the sail comes down.

Q. How does a trysail travel up and down the mast?

Ans. There is a bar riveted on the aft side of the mast called a traveller; on the traveller are hanks seized to the eyelet holes in the fore leech.

BOAT SAILS.

Q. What kind of sail is usual for a ship's lifeboat ?

Ans. Usually a lug sail ; sometimes a gaffsail, spritsail and a leg of mutton.

Q. Set a lugsail ?

Ans. Lay the yard and sail fore and aft over the thwarts on the lee side of the mast ; hook the strop on the yard to the hook on the mast ring (parral) and the tack to the eyebolt on the weather gunnel forward, hoist away and when right up trim the sheet. (Fig. 70).

LUG SAIL.

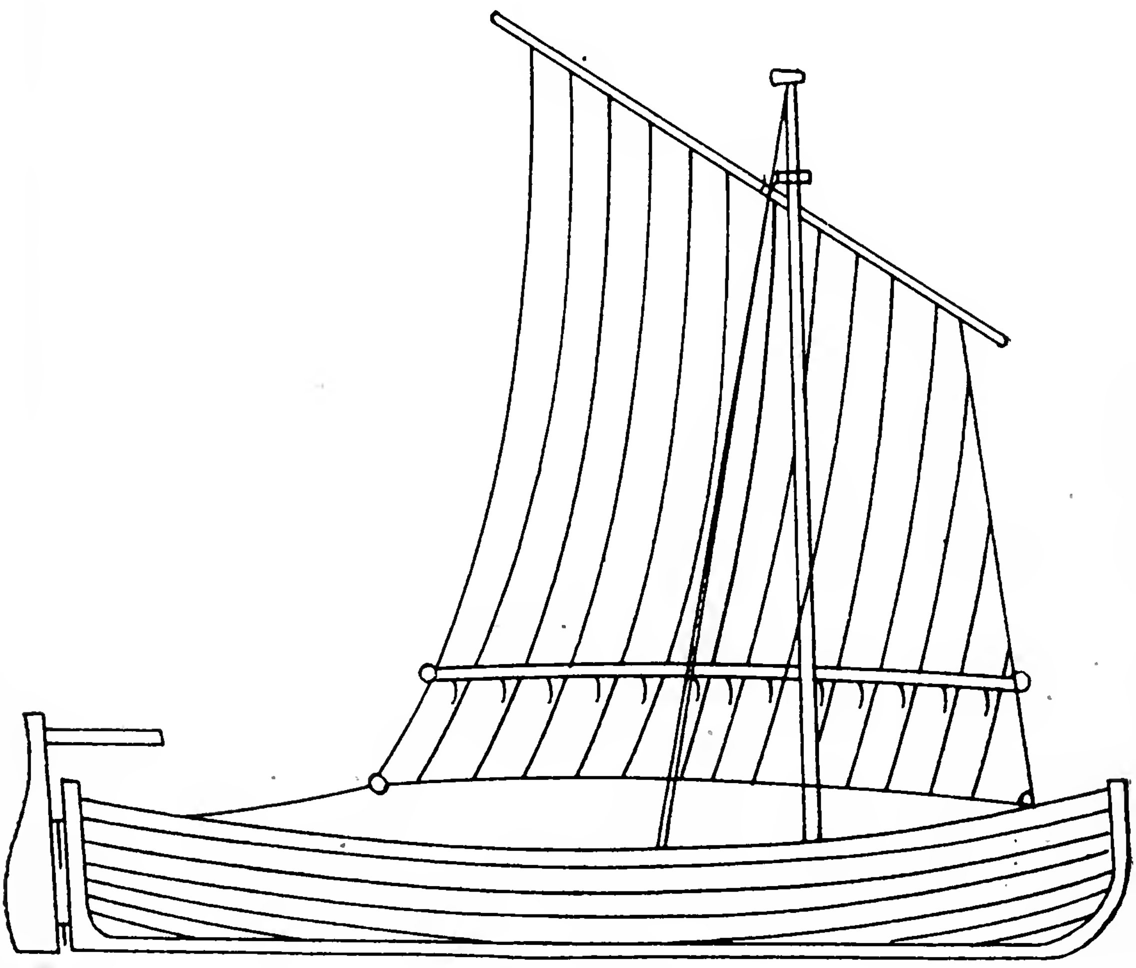


Fig. 70.

Q. Set a spritsail ?

Ans. Hoist the throat right up, place the upper end of the sprit into the peak of the sail and push the peak out ; put the lower end of the sprit in the becket at the foot of the mast, then haul aft the sheet. (Fig. 71).

SPRITSAIL.

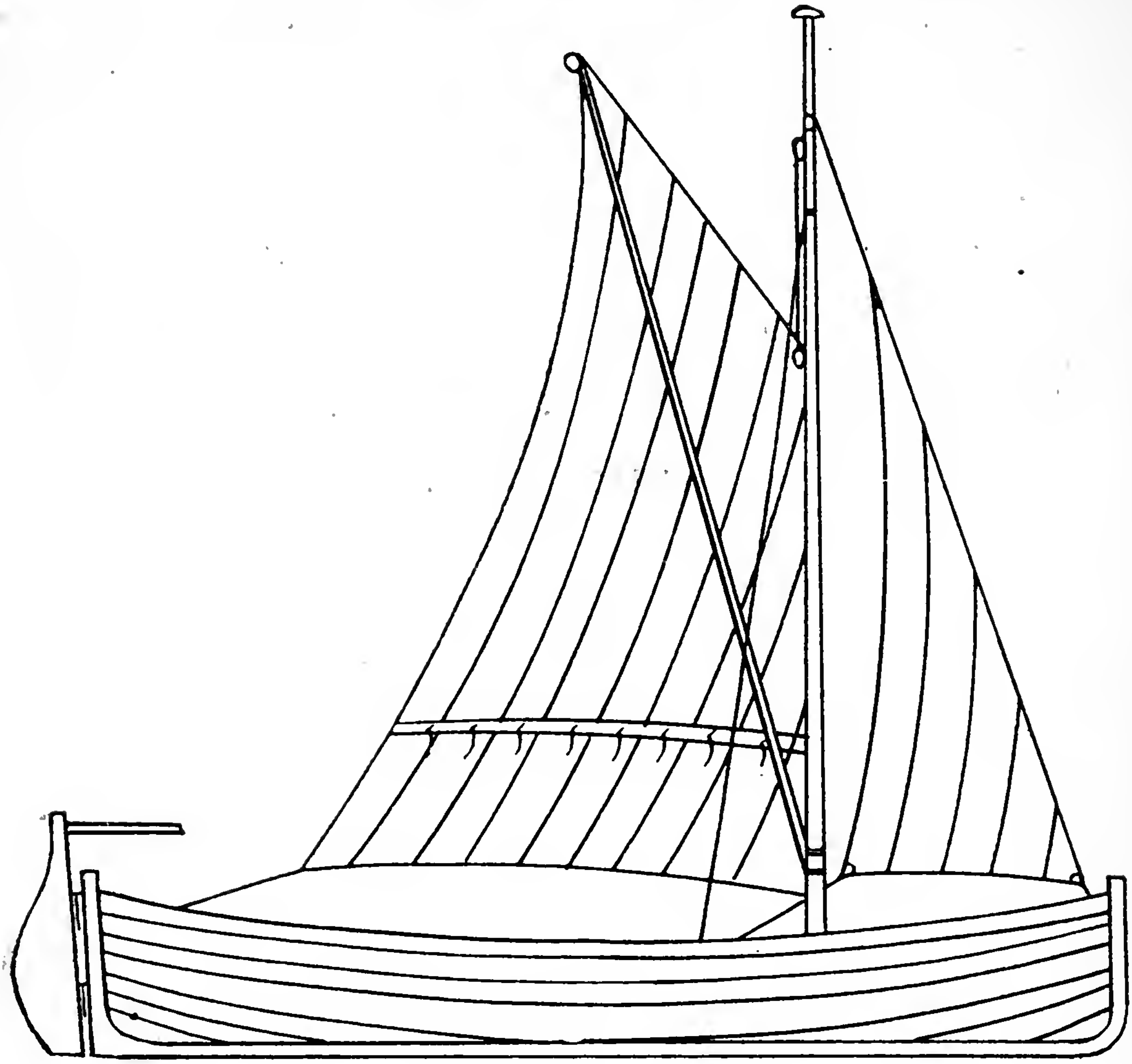


Fig. 71.

Q. Set a gaffsail?

Ans. Hoist away on peak and throat halyards, and when right up haul aft the sheet. (Fig. 72).

Q. Set a leg of mutton sail?

Ans. Hoist away with the halyards, then haul aft the sheet.

Q. Where would you make the sheet fast?

Ans. The sheet should never be made fast, it should be held in the hand with a turn round the cleat on the lee quarter.

Q. In an open boat, heavy sea, gale of wind; what would you do?

Ans. Ride to a sea anchor.

GAFF SAIL.

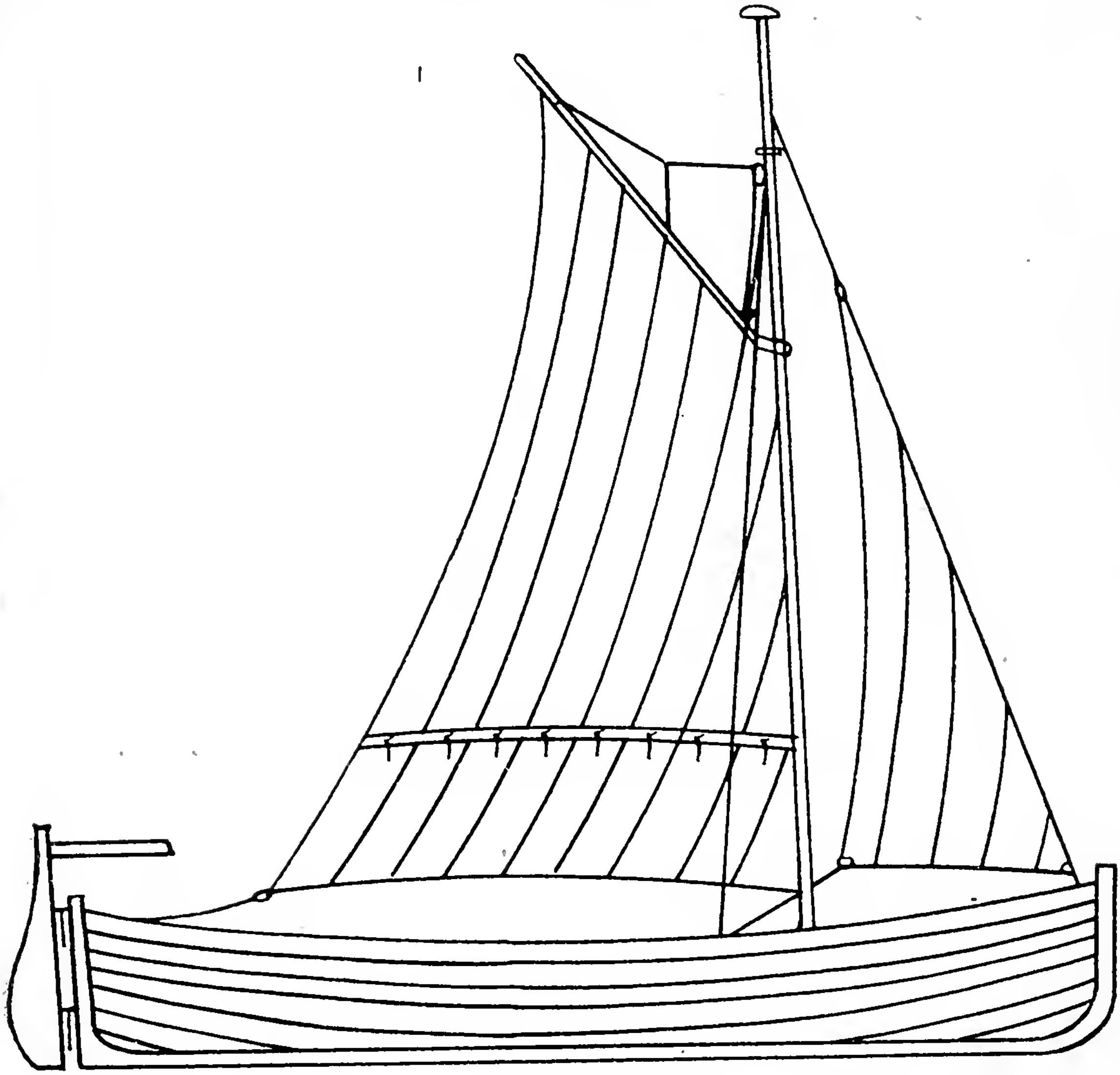


Fig. 72.

Q. How do you step the mast?

Ans. Place the heel in the step on the keelson, then raise the mast and secure it with the clamp on the thwart.

Q. How would you launch a lifeboat?

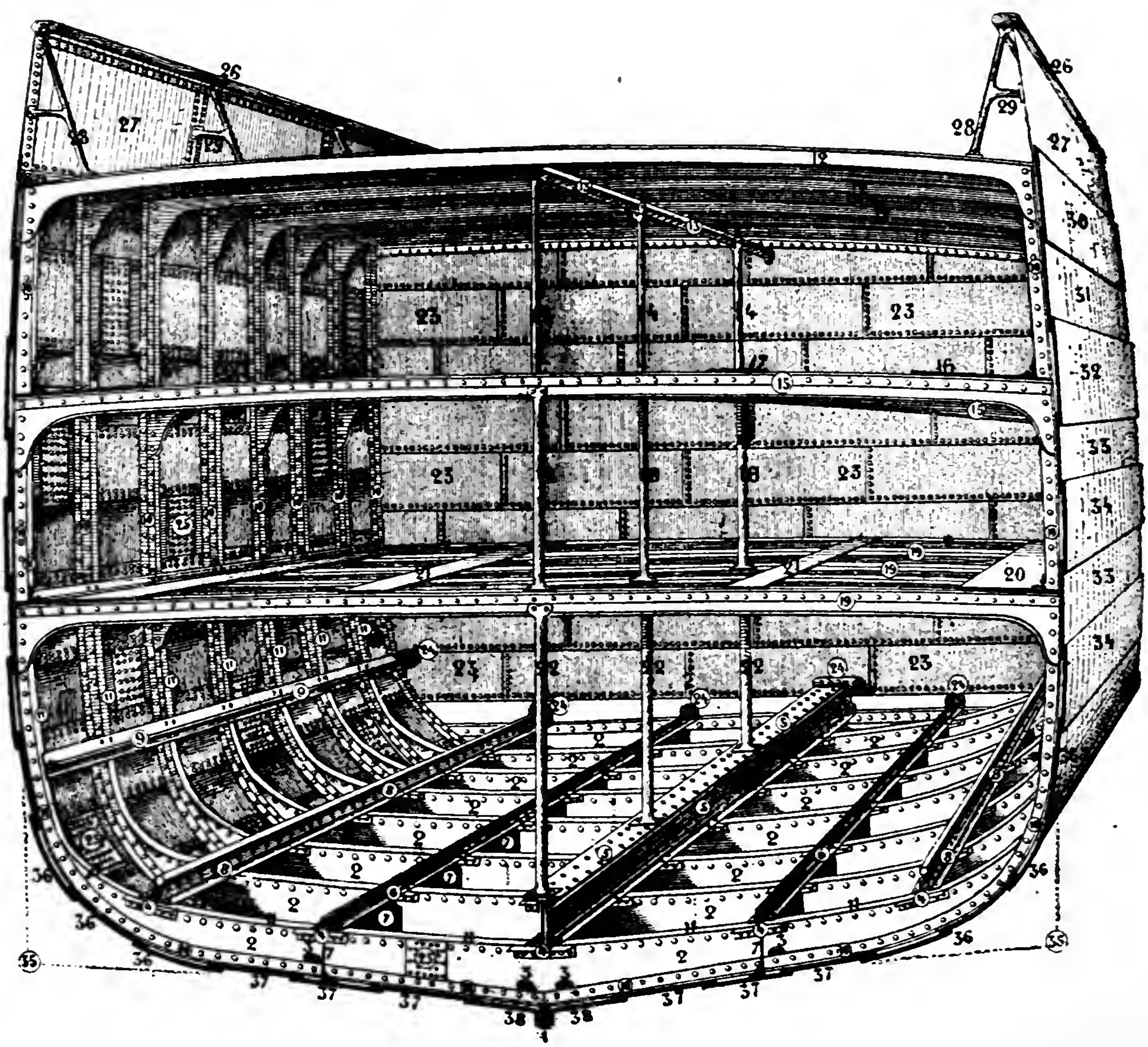
Ans. See the falls clear, take off the cover and strong-back, pass the painter well forward outside of everything and make it fast; ship the rudder and see that the plug is secure. Take the weight of the boat with the falls, down outside chocks, ease the bow out and push; the boat will swing out the davits, steady tight the davit guys, put the men in the boat and lower away. Directly the boat is in the water unhook the falls; after one first.

SHIP CONSTRUCTION.

Explanation of Fig. 73.

1 Keel; Bar keel.
2 Floors (continuous).
3 Water-courses or limber-holes
4 Lug pieces.
5 Keelson; Middle line keelson.
6 Side keelson.
7 Intercostal side keelson.
8 Bilge keelson.
9 Bilge stringer.
10 Frames.
11 Reverse frames.
12 Upper deck beams.
13 Central stringer or girder.
14 Upper deck pillars or stanchions.
15 Main deck beams.
16 Main deck stringer plate.
17 Main deck beam tie plate.
18 Main deck pillars or stanchions.
19 Lower deck beams.
20 Lower deck stringer.
21 Lower deck beam tie plate.
22 Hold pillars or stanchions.
23 Bulkhead.
24 Collars.
25 Butt straps.
26 Main rail.
27 Bulwark plating.
28 Bulwark stays.
29 Spurs.
30 Upper deck sheerstrake.
31 Topside strake.
32 Main deck sheerstrake.
33 Side plating, (inner strakes.)
34 Side plating, (outer strakes.)
35 Bilge.
36 Bilge strakes.
37 Bottom strakes.
38 Garboard strakes.

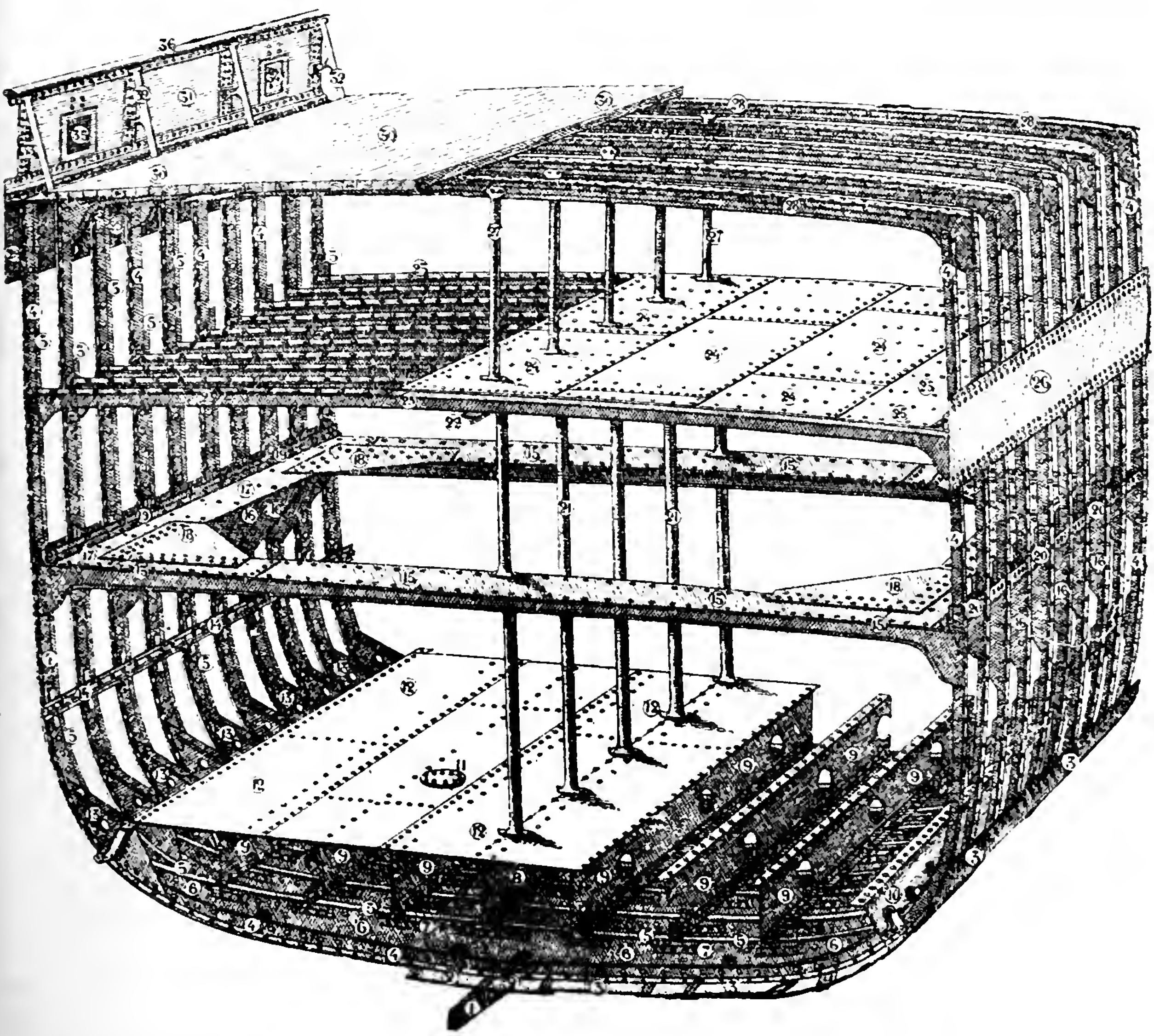
Inside View of an Iron or Steel Ship. Fig. 73.

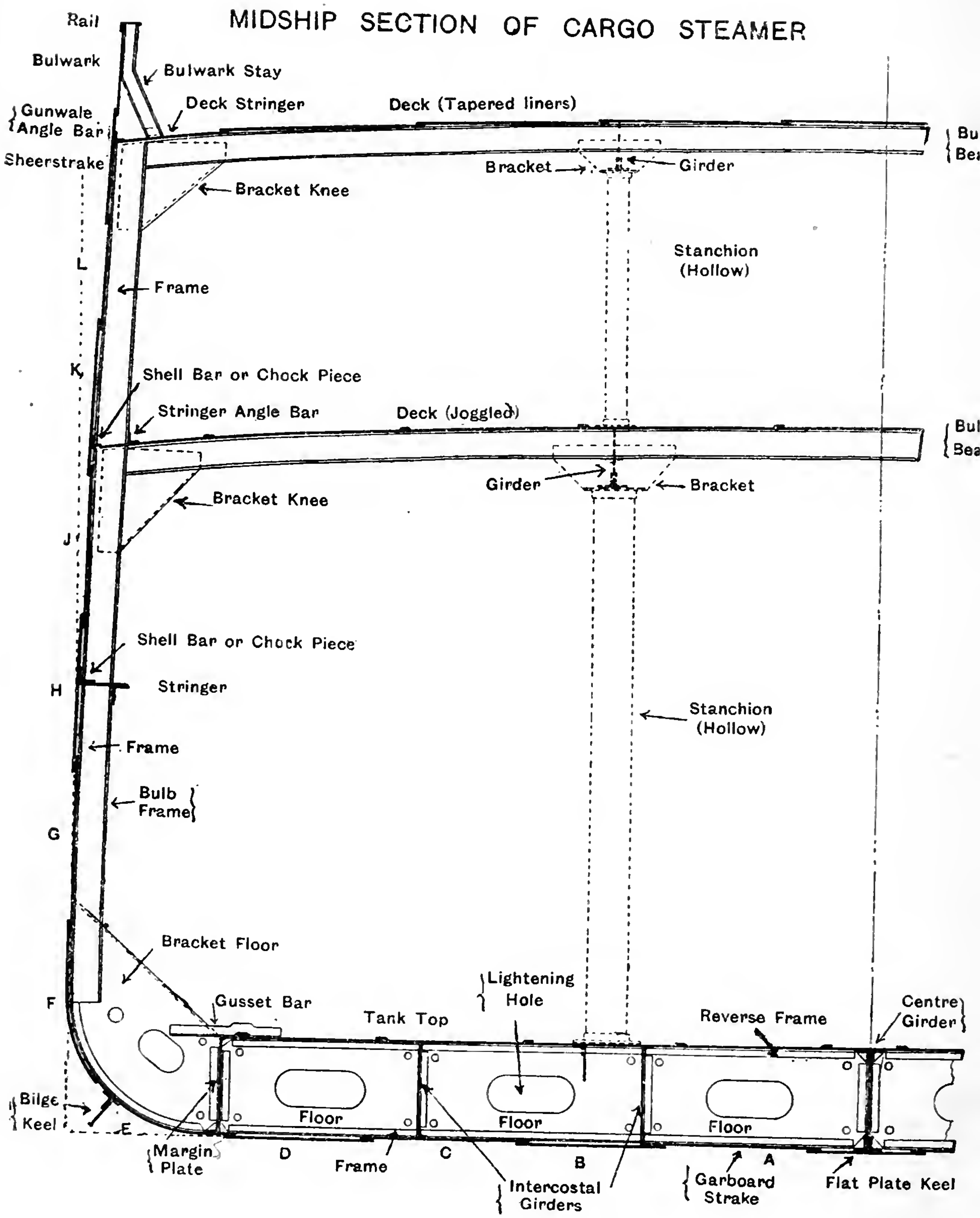


Explanation of Fig. 74.

1 Keel. (Bar keel.)
2 Garboard strakes.
3 Bottom plating.
4 Frames.
5 Reversed Frames.
6 Floor.
7 Lug pieces.
8 Centre girder.
9 Side girders.
10 Margin plate, (tank side.)
11 Manhole door.
12 Inner bottom, (tank top.)
13 Bracket frames.
14 Side stringer.
15 Hold beams (semi-box beams.)
16 Brackets.
17 Hold beam stringer.
18 Gusset plates.
19 Stringer inner angle bar.
20 {Stringer outer angle bar. Shell bar.}
21 Hold pillars or stanchions.
22 Central stringer or girder.
23 Main deck beams.
24 Main deck plating.
25 Main deck stringer.
26 Main deck sheerstrake.
27 Upper deck pillars or stanchions.
28 Upper deck beams.
29 Upper deck sheerstrake.
30 Upper deck planking.
31 Bulwark plating.
32 Bulwark stay.
33 Spur of bulwark stay.
34 Port, (freeing port.)
35 Port flap or port lid.
36 Main rail.

McIntyre Tank. Double Bottom on Ordinary Floors. Fig. 74.





CELLULAR BOTTOM

Fig. 75.

SHIP CONSTRUCTION.

Viva Voce for Second Mates, Mates and Masters.

Keels.

Keel. The principal frame of a ship ; it is the foundation upon which the whole ship is built.

Bar Keel. Lengths of solid bars of iron on steel scarphed together and extending from stem to stern.

Side Bar Keel. A vertical keel plate with plates on each side, the combined thickness and depth of side bars (plates) being equal to a bar keel.

Flat Plate Keel. A flat plate in the same place and in lieu of a bar keel.

Bilge Keel. A combination of angles and bulb plates fitted on the outside of each bilge, to lessen the roll of a ship. They are usually fitted to ships having flat plate keels and often termed " rolling chocks."

Longitudinal Frames.

Keelson. Girders running fore and aft on top of the floors, riveted to the reverse frames and lug pieces. They give longitudinal strength.

Middle Line Keelson. The principal keelson in the ship, it runs fore and aft over the floors and directly above the keel.

Side Keelsons. A keelson midway between the middle line and bilge keelsons.

Bilge Keelsons. A keelson fitted over the floors at the lower turn of the bilge.

Wash Plate. Plates fitted between the floors (fore and aft) midway between the middle line and bilge keelsons. They prevent water dashing from side to side as the vessel rolls.

Intercostal Keelsons. Plates fitted vertically and fore and aft, their upper edges connected to the keelson and their lower edges connected to the shell by short fore and aft bars. They are stronger than an ordinary keelson and should in all cases be fitted to side and bilge keelsons. With a bar keel, their fore and aft edges are connected to the floors with angles when fitted to a middle line keelson.

Stringer. Girders running fore and aft, fitted inside the frames, above the bilge. There are various kinds similar to keelsons; in fact they are the same as keelsons with a different name.

Bar Stringer. Two angle bars fitted back to back and connected to the reverse frames and lug pieces at the side of the vessel.

Hold Stringer. A girder fitted in the hold at the vessel's side, usually consisting of one or more continuous bars inside the frames, also a horizontal plate scored between the frames and connected to the shell with short angles called "chock pieces" or "shell bars."

Beam Stringer. A stringer running over the ends of beams and assisting to connect the beams to the side of the vessel. The stringer plate is riveted flat on the beams and connected to the side by shell bars. Continuous bars inside the frames are riveted to the plate and frames. There are various kinds.

Deck Stringer. A plate stringer at the beam ends fitted exactly as beam stringers. They take their names from the decks they belong, *i.e.* :—Lower deck stringer, orlop deck stringer, main deck stringer, upper deck stringer, bridge deck, &c. An upper deck stringer plate is connected to the shell by a continuous bar, called a "gunnel angle bar."

Bilge Stringer. A stringer fitted at the upper turn of the bilge.

Transverse Frames.

Frame. An angle bar extending from the keel to the upper deck. In an ordinary ship they are in one piece, but in cellular bottoms they are usually cut at the margin plate. There are in modern ships three kinds :—bulb, channel and zed. In the fore part of the vessel, the shell flange points aft, and in the after part, forward.

Reverse Frame. An angle bar extending from the keelson to various heights up the side of the vessel. It is fitted in a reverse manner to the frame, *i.e.* :—the fore and aft flange pointing forward in the fore part of the vessel and pointing aft, abaft amidships. The frame and reverse frame are riveted back to back up the side of the ship and separate at the end of the floor (upper turn of the bilge), the frame following and being connected to the lower edge of the floor and the reversed frame to the upper edge.

Ships with bulb, channel and z frames, do not have reverse frames at the side, they only extend to the upper part of the bilge.

Ships with cellular bottoms usually have the reverse frames cut at the margin plate.

Floors. Vertical athwartship plates fitted at every frame (sometime alternate frames) extending from bilge to bilge. The reverse frames are riveted to the top of the floor and the frames at the bottom. In small vessels without cellular bottom, they are usually in one piece ; in larger vessels two pieces lapped or strapped at the middle line or at the side of the middle line.

With cellular bottoms the floor is usually in four pieces, from centre girder to margin plate on each side, and from margin plate to bilge on each side (bracket floor).

Beams. Horizontal ties to connect the sides of the ship and carry the decks. They give transverse strength and keep the sides of the vessels in their relative positions. With the assitance of the stringer they are connected to the side with knees riveted to the frames. There are various kinds :—Angle, bulb angle and channel for iron decks ; bulb plate with angles and T bulb (butterly) for wooden decks and H beams and semi-box beams for beams of extra strength when required in engine room and holds.

Pillars or Stanchions. Vertical ties to support beams and decks. They may be fitted at every beam, but in recent years, to save space and strength, a few large pillars of extra strength, combined with girders under the beams, have been fitted in lieu of pillars at every beam.

Web Frame. Frames of extra depth, consisting of a web plate riveted to the frame, and double reverse frames (sometimes single) riveted on the inner edge. Web frames are fitted to compensate for the absence of hold beams or lower decks ; they are placed at every eighth frame in holds 16 ft. in depth, and four frame spaces apart in holds 28 ft. in depth.

Deep Frames. Frames of extra strength at every frame; they are simply frame and reverse frame with deep transverse flanges riveted together with an overlap of $3\frac{1}{2}$ inches. They compensate for absence of hold beams and decks.

Bulb Frame. Used in lieu of frame and reverse frame; the bulb is equivalent in strength to the reverse frame.

Channel Frame. Used in lieu of frame and reverse frame, and saves the cost of riveting the two parts, as the channel like the bulb angle is one rolled bar.

Zed Frames. Z frames are mostly used in turret ships and in the Royal Navy. They are stronger than frame and reverse frames, because they are solid bars in one rolled section. The reason they are seldom used in the Merchant Service is the expense of bending and bevelling.

Frame Section. The component parts, frame, reverse frame, floor, beam and pillar are all joined, and form the frame section. The spacing between the frames varies from 21 to 30 inches. The principal function is to stiffen the shell and give transverse strength.

Bulkhead. A partition by which compartments or holds are separated one from another.

Each watertight bulkhead will have to be strong enough to withstand the pressure of water against it when any compartment is filled with water.

They are stiffened with vertical angles about 30 inches apart, and sometimes in addition with horizontal stiffeners 4 feet apart. They are either connected between double frames or to single frames of extra strength.

All steamships must have at the least four watertight bulkheads, and when the length exceeds 285 ft. an extra bulkhead for every 70 ft. of length.

Framing at ends of Vessel.

Stem. A heavy casting or forging of steel or iron, extending from the keel to above the forecastle deck. It is scarped to a bar keel and joined to a flat plate keel. Its principal function is to connect the hood ends.

Hoods. The foremost and hindmost plates, connected to stem and sternpost.

Breasthooks. Horizontal triangular plates immediately abaft the stem at every deck and stringer and between decks and stringers, usually 4 ft. apart. They strengthen the plating at the fore end and connect the sides of the vessel; they also connect the side stringers one to the other. At the after end of the vessel they are called **crutches.**

Panting. Owing to a ship suddenly tapering away towards the ends, especially the bow, a loss of structural strength is yielded, and the shell on each side of the bow is liable to "pant." The principal methods to resist panting are :—Closer spacing of frames, double frames, an extra tier of beams called **panting beams,** broadening of the stringers called **panting stringers**, floors of extra depth and thicker shell.

Stern Post. A heavy casting or forging of steel or iron, extending from the after end of the keel to the upper deck. It is scarphed to a bar keel and fastened to a flat plate keel at the lower part, and fastened to the transom floor at the upper end. Its principal function is to connect the after hoods and to support the rudder. Sailing vessels, paddle boats, and steamships with twin screws have stern posts.

Stern Frame. A heavy forging or casting of steel or iron for steamships with single screws. The functions of a stern frame are the same as a stern post, but in addition an aperture and boss have to be provided for the propeller and tail shaft, and owing to the enormous stresses from the propeller, a stern frame is from two to three times thicker than a stern post. In small vessels they are forged or cast in one piece, but in larger vessels they are forged in two or more pieces and the parts scarphed when put together.

The parts of a stern frame are :—Propeller-post, boss, rudder post, arch piece, sole piece, keel piece heel and head.

Transom Floor. A transverse floor at the head of the stern post or stern frame to which they are attached with angles. The stern frames which stiffen the counter are all of them connected to the transom floor with brackets and angles.

Stern Frames. Frames connected to, and radiating from the transom floor, forming the shape of the vessel's stern and to which the plating round the stern abaft the rudder head is riveted.

Rudders.

Frame Rudder. A frame rudder is a forged frame, plated on each side, and the space between the plates is filled in with wood.

Single Plate Rudder. This rudder consists of a main post with arms shrunk on. These arms are about 5 ft. apart, and the plate is slid between these arms (alternate arms on the same side) right into a grove on the aft side of the main piece. The arms are riveted to the plates.

Gudgeons. Ears forged on the aft part of the stern or rudder post, for the rudder pintles to fit into.

Use of Rudders. Primarily to steer the ship. They should not be hove to one side more than **40°**, which is the angle of efficiency; **stop cleats** or other arrangement are fitted either to the rudder or stern post to stop the rudder from going over too far; one of the pintles is a **locking pintle** to keep the rudder from being unshipped in a seaway. Some pintles are cast to the rudder, they are now usually portable. The **lower pintle** rests on a **convex** steel bearing and supports the weight of the rudder.

Stuffing Box. A box at the top of the rudder trunk packed at the upper deck with lignum vitæ or other efficient packing, to steady the rudder head and prevent it from jerking, also to stop water rushing up the rudder trunk on to the upper deck.

Quadrant. A heavy casting or forging placed on the rudder head in lieu of a tiller; the wheel chains from the steam steering engine are shackled to it.

Crosshead. A strong bar at the top of the rudder head to connect the rods or arms of the hand screw steering gear.

Ceiling and Sparring.

Ceiling. Wood planking about $2\frac{1}{2}$ inches in thickness laid over the floors and fastened to the reverse frames on each side of the keelsons; between the keelsons it is usually fitted in short hatches close fitting with the fastened ceiling. This ceiling must be close fitting at edges and butts, to prevent dirt or cargo getting through on to the bottom of the ship, and at the upper part of the bilge it must be close against the ship's side and cemented.

When laid on the tank top there are no fastenings, the planks are laid close together so as to be easily lifted. The ceiling in this case is to protect the tank top.

Sparring. Cargo battens above the bilge right up the side of the ship to keep some cargoes off the shell. The battens are sometimes fastened to the reverse frames with nut and screw bolts, but in modern ships they are mostly dropped into cleats fitted to the frames and thereby secured in a portable manner, and easily unshipped for cleaning and painting.

Plating.

Shell. The shell is the heaviest and strongest part of the structure of a vessel and therefore the most important. It is stiffened by transverse and longitudinal frames, to withstand the stresses and strains a ship is subject to in a seaway.

Sheer Strake. The uppermost strake of shell plating and adjacent to the upper deck beams where hogging and sagging are first experienced; for this reason the upper sheerstrake is the thickest strake of plating and extends 6 or 7 inches above the gunwale angle bar.

Garboard Strake. The strake next to the keel and connected thereto. It is riveted to a flat plate keel in exactly the same manner as other strakes are connected, but the connection to a bar keel and side bar keel is vastly different, the plate have to be heated and the inner edges bent to fit against the keel; all parts are riveted together with long rivets, and this is the only connection a bar keel has to the ship; for this reason a bar keel is often called a "hanging keel."

Bilge Strake. A strake with plates of substantial thickness running along each bilge where considerable stresses are encounted.

Deck Plating. A vessel with complete iron or steel decks is much stronger than a vessel with only a wooden deck. There is no recognised strength in a wood deck, and in large vessels they are not allowed. Deck plating is riveted to the beams in various ways. In old ships the system is usually the same as the side plating (inner and outer strakes) called raised and sunken strakes, where parallel liners are required between the beams and raised strakes. Modern ships usually have one edge over and the other under adjacent strakes with tapered liners.

Boss Plate. A curved plate covering the boss of a propeller post and the curved portion of the after frames in the way of the stern tube ; it is a much thicker plate than other plates in the same strake.

Deckhook. The most forward plate immediately abaft the stem, joining the deck stringer—the same as a breasthook, they are both synonomous.

Oxter Plate. A much flanged plate under the counter above the aperture. There is one on each side of the sternpost.

Coffin Plate. The aftermost plate of a flat plate keel, roughly resembling the shape of coffin, as it is bent on each side to form a channel, where the keel piece of the sternframe is fitted and securely riveted.

Joggling. To save liners between frames and outer strakes, and between beams and raised strakes, the plates are now mostly joggled, thus saving weight and expense. Deck plates, shell plates and tank tops are joggled so that the outer strakes on the frames, deck plates on beams and tank tops on reverse frames fit close to each other.

Another method is to joggle the frames, beams and reverse bars. This method is not visible from the outside and can only be seen inside the vessel.

Decks.

Wood Decks. Wood decks in iron or steel ships have no structural strength, and only provide a platform to walk on and keep the water out out of the ship. They are bolted to beams fitted to alternate frames. When a wood deck is laid over an iron or steel deck it is bolted to the latter between the beams and assists in making a stronger deck as it stiffens the iron or steel deck.

Iron Decks. Iron or steel decks are much stronger than wood, as they form a continuation of the sides of the vessel ; the latter may be considered approximately a steel cylinder with closed ends. Iron decks are usually riveted to beams at every frame.

Hatchways. Hatchways are formed with coaming plates connected to the deck with continuous bars ; the fore and aft coamings are also connected to the ends of the half beams with lugs riveted to beams and coamings and the athwartship coamings are also riveted to the flat side of transverse beams at the ends of the hatch.

Owing to the loss of strength through the large opening in the deck, compensation has to be provided by means of shifting beams which are connected to the fore and aft coamings by nut and screw bolts, the number of shifting beams required depending upon the length of the hatch. The whole forms a substantial framework for the hatches and prevents the seas from bursting them in.

Tie Plates. There are two kinds, longitudinal and diagonal. The former are fitted in all vessels except when an iron or steel deck is laid; the latter are placed on the beams of sailing vessels having only wooden decks.

Longitudinal Tie Plates are laid fore and aft on each side of the hatchways and extend the full length of the deck; their principal function is to stiffen the beams and to keep them in their relative positions.

Diagonal Tie Plates are fitted on the beams of all sailing vessels at the upper deck, they are riveted to stringers, longitudinal tie plates and beams the full length of the deck. They are also fitted to lower decks in the way of the masts. Their principal function is to resist the strains communicated to the deck by the wind pressure on the masts.

Mast Partners. A substantial plate riveted to the beams of vessels with wooden decks in the way of the masts; a hole is cut in the middle for the mast and round this hole a stout angle ring is riveted to the partner, in order to resist the wedging at the mast.

Bulwarks. Bulwarks are erected primarily for the comfort and safety of the crew, yet at the same time they perform other useful functions, as in sailing vessels; most of the running gear is belayed to the main rail, the lower braces lead through blocks on the main rail, the fore and main sheets lead through sheaves in the bulwark plates, skids for boats rest on the bulwarks, and boat's davits are supported by the same.

They are supported by stays or stanchions riveted to the deck and bulwarks, and are riveted to the sheer strake. Sailing vessels usually have them about two feet higher with an extra rail above the main rail called **topgallant bulwarks.**

Ports for freeing the water from the decks and for passing through hawsers or chains for mooring are fitted; the freeing ports are fitted with lids which are hinged in various ways, they always open outwards to allow the large volumes of water to have a free passage overboard.

Scuppers. Round or oval holes cut in the upper part of the sheer strake, with their lower surfaces flush with the stringer plate; they are for freeing the deck of small quantities of water. The gunwale bar is usually cut at the scupper, and compensated for so doing by a short angle below the stringer plate, riveted to the sheer strake and stringer.

Chain Plates. A strong piece of plate riveted to the inside of the sheer strake in the wake of the various masts, and to which, shrouds and backstays are connected to eyes at their upper ends, to set up lanyard or screw rigging.

Bitts or Bollards. Strong castings with iron heads, securely fastened to an upper deck, bridge deck, poop and forecastle, for belaying hawsers, warps, &c.

Water Ballast Tanks.

McIntyre Tank. A water ballast tank in the bottom of the ship. The ship's bottom forms the bottom of the tank and the tank top or inner bottom is supported by longitudinal girders, fore and aft, 3 ft. apart, resting on and secured to ordinary floors.

The tank side or margin plate forms a watertight connection with the side of the vessel. The frames and reserve frames are cut, and the upper part of the margin plate is flanged and connected direct to the tank top, the lower edge is connected to the shell of the ship by a continuous angle bar.

Compensation for the loss of strength, by cutting frames and reverse frames, is provided by the brackets on the outside of the tank also on the inside connected to the floors. There are various methods of making a watertight connection with the shell, and sometimes instead of cutting the frame, watertight collars are fitted. (Fig. 74). This system is expensive and not so satisfactory as the cutting of the frames.

Cellular Bottom. A cellular double bottom is divided into cells by means of fore and aft girders and transverse floors. Both girders and floors are the same depth as the tank, which is entirely different to the McIntyre tank.

In modern steamships the centre girder is connected at its lower edge to the flat plate keel by double angle bars, and the side girders connected to the bottom plating by single angles. The number of side girders depends upon the breadth of the vessel ; there are four side girders on each side of the centre or middle line girder when the breadth of the ship is between 60 and 72 feet.

The floors are connected to the centre girder by single or double angles, and the inner bottom or tank top is connected to angles riveted to the top of the girders and the reverse frames on the top of the floors.

There are many types of cellular double bottoms, the two principal kinds being :—Continuous girders with intercostal floors and continuous floors with intercostal side girders. The latter type is now the most common in the present day steamship, and in either type the watertight connection at the side of the ship is the same as in the McIntyre tank—both frame and reverse frame being cut and compensation effected by the brackets outside and the floors inside of the tank.

Sometimes the floors are fitted to alternate frames instead of at every frame, and it is now a common practice to have no margin plate, the tank top going right out to the side of the vessel, and provision is made for water in the hold to drain into a well constructed between two floors.

Types of Vessels.

Three Deck Vessels. A ship with three continuous decks, having her full strength carried right up to the upper deck.

Spar Deck Vessel. A three decked vessel not quite as strong at the upper deck and the upper deck side plating as the ship built under the Three Decked Rule. These vessels are no longer provided for by Lloyd's Rules.

Awning Deck Vessels. When instead of topgallant forecastle, bridge deck and poop, the open spaces between these erections are closed in with a continuous deck and side plating, the ship will then be either an Awning or Shelter Deck Vessel, according to whether the deck covers space measured for tonnage, or whether there are " tonnage openings " in the deck so that the space may not be measured for tonnage. The former is the Awning Decked Vessel and the latter the Shelter Decked Vessel.

Shelter Deck Vessel. A vessel exactly the same as an Awning Decked Vessel with the exception of " tonnage openings " in the upper deck, so that the space beneath this deck will not be measured for tonnage dues.

Raised Quarter Deck. A deck at the after end, raised a few feet above the upper deck and so named to distinguish it from a full poop under which the upper deck is continued right aft. There is usually no deck under the raised quarter deck, as the main deck stops at the " break bulkhead " at the fore part of the raised quarter deck.

These decks usually extend from right aft to the bridge deck, where they stop about 4 ft. lower than the latter. In the earlier types they only extended the same distance forward as a poop, and were so named ; the cabin floor was dropped about 4 feet below the main deck to allow for accomodation.

Shade Deck Vessel. A light deck above the main deck, generally extending the full length of the vessel, as a protection from the weather. The sides of the vessel between the main and shade deck are open and there is no side plating the same as the awning and shelter decked vessels.

Butt-strap. A piece of plate by which adjoining plates are connected endwise.

Angle-strap. A piece of angle by which adjoining angles are connected endwise.

Butt-lap. The riveting of the fore and after edges of shell plates by overlapping instead of connecting them with a strap.

MATE'S DUTIES AND SEAMANSHIP.

Q. What would you do on first joining a ship ?
Ans. Report myself to the master, if he is on board.

Q. And then ?
Ans. I should have a general overhaul of all standing and running gear, especially every part that is liable to be chafed. I would have the chafing mats off, and renew them where necessary. If there is time to rouse up the chain cables, and see that the ends are properly stoppered, and that there are no faulty links nor worn shackle bolts.

Q. Your ship is loaded ; what would you be sure to see to before going to sea ?
Ans. That the hatches were properly secured, the pumps in good order, and the lead line ready (ques. 4, p. 14).

Q. Where would you be stationed in going to sea ?
Ans. At the bows.

Q. What for ?
Ans. To let go an anchor at a moment's notice, if required.

Q. What would you do before letting go a patent anchor ?
Ans. Slack it out a little to make sure of it starting.

Q. How would you make a lee side for a lighter.
Ans. Clap a spring on the cable from the quarter and slack away the cable until the ship's head pays off enough.

Q. Your are in a tender ship (without ballast tanks) and are nearly discharged, what would you be careful about ?
Ans. Keep in sufficient cargo for stiffening and take in part of the loading cargo before finishing discharging. In some docks ballast booms are to be had, which placed on each side (floating) with chains hauled tight from the ship, keep her upright, and enables one cargo to be discharged before starting to load the next.

Q. At sea, if a gale has been blowing for the last three or four days, and now has passed off, what would you do ?
Ans. Examine everything aloft to see that nothing has chafed, &c., and sound the pumps.
Q. Taking in cargo from lighters ; the lighters come off irregularly ; what would you do ?

Ans. Note the time that one finished, and the time the next commenced.

Q. What would you do on receiving the goods from the lighter ?

Ans. I would keep tally, and if all is right I would sign one of the boat notes brought off by the man in charge, and keep the other.

Q. If you were discharging cargo into a lighter ?

Ans. Get a receipt from the man in charge of her.

Q. If any goods should be sent off to you in a damaged state ?

Ans. I should call the captain's attention to them before giving a receipt, and he would use his own judgment about receiving them.

Q. Riding in an ordinary case, at slack water, there is no wind, what would you do ?

Ans. Heave dead short.

Q. If you have been below all night how could you tell in the morning if your anchor were fouled ?

Ans. Only by sighting it.

Q. What is the principal rule in casting a sailing ship, (at anchor) when near rocks or shoals ?

Ans. Always cast her towards the danger, if possible.

Q. How would you carry out a steam anchor ?

Ans. Hang the anchor to the stern of the boat by the ring in the same manner as it is hung at the cat-head, pass a shank painter under one of the flukes, and heave the two parts forwards to about the amidships of the boat. Place the chain or wire in the bows.

Q. How would you moor with two anchors and forty-five fathoms of chain ?

Ans. Drop the working anchor first, and pay out 90 fathoms of chain, then let fall the other bower ; throw all aback, heave in one chain, and pay out the other till there are 45 fathoms of each out.

Another plan is :—Let fall one anchor and throw all aback ; pay out 90 fathoms and let go the second anchor ; heave in on the first cable and pay out on the second, till there are 45 fathoms of each out.

The same way for a steamship, with the exception of throwing aback, as she can work under her own steam.

Q. How would you pick them up next day ?

Ans. Pick up the lee one first, (the one you are not riding to.)

Q. How would you cast your ship in getting under weigh ?

Ans. *If to Starboard*—Haul on my port fore braces, and let my after-yards lie square. I may hoist the foretopmast staysail, and keep the sheet to windward to help her.

If to Port—Haul in the contrary braces. When cast, fill the head sails and brace up.

Q. You want to get under way ; you are hove dead short, wind on the bow, there is a rock right aft ; what would you do ?

Ans. Give her a broad sheer, back everything, and let her dredge.

Q. Supposing there was no wind, tide right ahead ?

Ans. Give her a broad sheer, and let her dredge.

Q. Riding in a bay, wind and sea rising and coming right in ; you want to slip and get out to sea ; how would you cast her ?

Ans. Trim the yards for the tack I am going to sail out on, set topsail and a few fore and aft sails, have other sails loosed and ready for setting ; get a spring (good warp) from what will be my weather quarter and make fast to the cable below the hawse pipe, haul the spring tight and make fast, slack away the cable when sure she will pay off the right way ; when she fills, slip cable and spring (have them buoyed) and set the other sails.

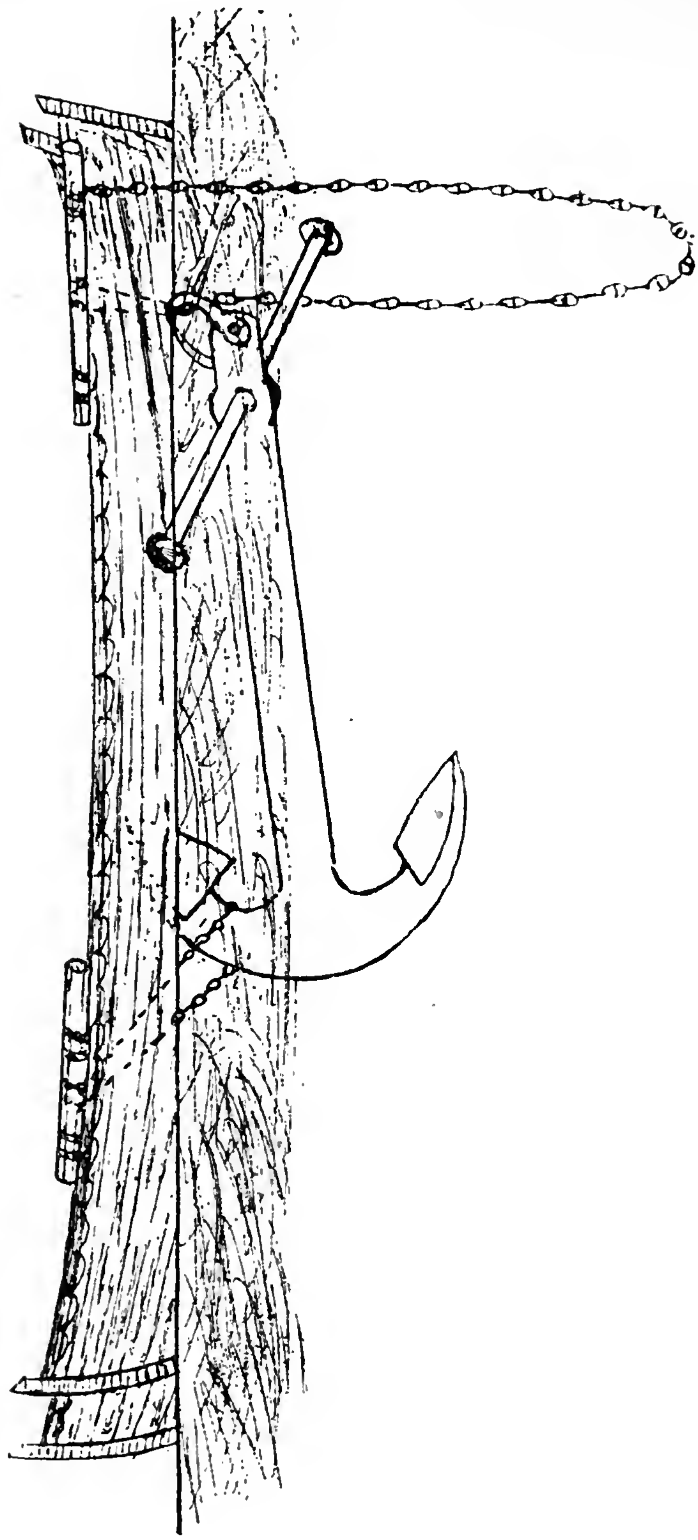
Q. Whenever you have to slip from a cable what would you do ?

Ans. Buoy the cable and spring, they can then be picked up when you come back after the weather has moderated.

Q. How would you carry a bower anchor out, also 90 fathoms of chain ?

Ans. Lash a spar across the gunwales of two boats, leaving space between the boats for the fluke of the anchor; lower away the anchor from the ship, hang the upper fluke from this spar, lash another spar across the after part of the boats and hang the head of the anchor from this spar ; the anchor is now placed with the flukes (vertical) and shank horizontal) between the boats and the stocks (horizontal) under the sterns of the two boats, lower as much chain into

Fig. 76.



CARRYING OUT ANCHOR WITH 2 BOATS.

the boats as they will safely carry, haul the boats off by means of a warp made fast to a kedge which has been previously run away, pay out enough chain to let the anchor reach the ground, then let go both slings together ; the boats can now be unlashed, and as one boat is paying out chain, the other boat will be going off to the ship for more. (Fig. 76.)

Q. How would you carry a bower anchor out with one boat?

Ans. Lash a good spar across the middle of the boat with the ends projecting over the gunwale at each side, lower the anchor from the ship into the water with the ring or shackle at the surface; place the boat over the anchor and

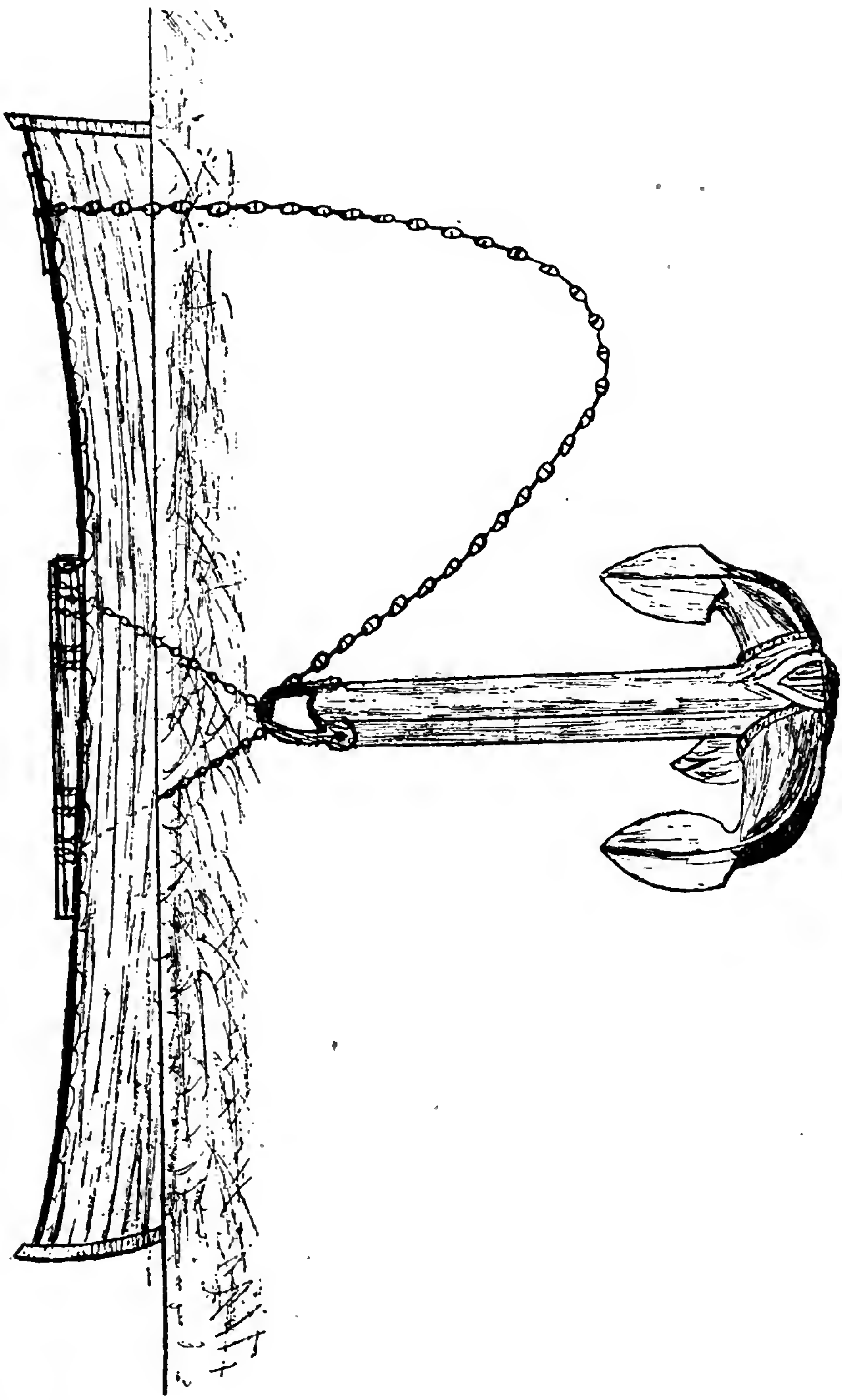


Fig. 77.

CARRYING OUT ANCHOR.

reeve a good rope, wire or chain through the shackle and make fast round each end of the spar, hauling well tight, lower away from the ship and let the boat take the weight of the anchor ; slack away the first length of chain into the boat and haul off to a kedge that has been previously run away. Pay out sufficient chain to allow the anchor to reach the bottom, then let go the anchor, and haul back to the ship paying out cable ; if there is not sufficient chain to reach the ship, buoy the end and go back for more, or if you have hands enough send off the required cable in another boat. (Fig. 77.)

Q. How would you protect the gunwale when paying out chain ?

Ans. Lash a spar over it, to slide the chain over.

Q. You are lying close to a river bank or a sloping breakwater ; it is blowing a gale right on the off side of your ship ; you have an anchor broad off from the bow and another broad off from aft to keep the ship off the bank side ; the anchors will not hold, what will you do ?

Ans. Boom her off from the shore with stout booms. one from the bow and another from the quarter.

Q. A sailing ship moored to a buoy forward, wind ahead, another ship close astern, get under way ?

Ans. Heave the ship close to the buoy ; trim the yards for the tack I am going to sail out on ; set topsails and a few fore and aft sails, have other sails loosed and ready for setting ; get a spring (good warp) from what will be my weather quarter and make fast to the buoy. Heave on the warp to spring the ship ahead, cant her with the head sails and helm, let go forward, still heaving on the warp until it is no further use, then let go.

Q. How would you get under way from your anchor in a sailing ship during slack weather.

Ans. Heave short ; brace up the after yards for the tack I am going on and box the fore yards ; set the topsails and a few fore and afters, have other sails loosed and ready for setting ; hoist the fore topmast staysail, sheet to windward. Man the windlass and trip the anchor ; the staysail, sheet to windward and fore yards will box her off, and when full haul round fore yards. Heave up the anchor, cat and fish it, trim yards and set sail.

Q. How would you cat and fish an anchor?

Ans. Overhaul the cat tackle and hook the cat block to the ring of the anchor, heave away on the cat fall until the ring is close to the cat head. Hook the fish pennant to the after fluke and hook the fish tackle to the other end of the pennant; heave away on the fish tackle, heaving the fluke up to the gunwale, secure with a shank painter and pass the ring stopper, unreeve the cat fall and take the cat block on board; reeve the cat fall afresh through the cat head and ring of the anchor: heave the ring close up to the cat head and haul tight the ring stopper. The anchor is now ready for letting go again.

SHIP'S BOATS AND LIFE SAVING APPLIANCES.

Attention is called to the fact that the boats, life-buoys, life belts, and other life-saving appliances on board all ships must be kept so as to be at all times fit and ready for use, and that a heavy penalty is incurred under section 430 of the Merchant Shipping Act, 1894, when this is not done. The Master of a British ship was recently fined the maximum penalty of £50 for failing to comply with this section.

To ensure that the appliances are always ready for use, it is necessary that the boats should be regularly swung out, put into the water and exercised, and that the life belts and buoys should be freqnently examined.

In accordance with section 9 of the Merchant Shipping Act, 1906, a record must be kept in the official log-book of every occasion on which boat drill is practiced and the life saving appliances are examined, each entry being made as soon as possible after the drill or inspection to which it relates.

Any person who wilfully makes a false or fraudulent entry in an official log-book is liable on summary conviction to a penalty not exceeding £100.

SHIP'S LOG.

Q. What entry would you make in your log after anchoring?

Ans. The time, depth of water, which anchor is down, how many fathoms of cable are out, and bearings of two fixed objects.

Q. What entries would you make day by day at sea?

Ans. The courses steered and distances run, winds and weather, latitude and longitude by observation and dead reckoning, sail made or taken in, and generally the work done by the crew, *and name how many inches of water you found in the pump well, and that you pumped it out*, also any damage the ship may have received.

OFFICAL LOG.

Q. What entries are made in the Official Log?

Ans. Births, deaths, marriages, convictions. punishments, fines, forfeitures, illness of any of the crew, character and conduct of each member of the crew. collisions, &c.

Directions from Official Log Book in the Home Trade.

1. All ships, of whatever tonnage, except those trading exclusively between Scottish ports, must carry an Official Log Book.

2. The importance of keeping the Log properly and duly making all the entries at the proper time, and with the strictest regard to form, cannot be too strongly impressed upon Ship Masters. By neglecting to do so they subject themselves to heavy penalties, and their owners to serious loss and inconvenience

3. Every entry is to be made as soon as possible after the occurrence to which it relates, and if not made upon the same day as the occurrence to which it relates, shall be made and dated so as to show the date of the occurrence and of the entry respecting it.

4. The following offences in respect of Official Log Book shall be punishable as hereinafter mentioned: that is to say—

   a. If in any case an Official Log is not kept in the manner hereby required, or if any entry hereby directed to be made in any such Log Book, is not made at the time and in the manner hereby directed, the Master shall for each such offence incur the specified penalty herein mentioned in respect thereof, or where there is no such specific penalty, a penalty not exceeding five pounds.

b. Every person who makes or procures to be made or assists in making any entry in any Official Log Book in respect of any occurrence happening previously to the arrival of the ship at her final port of discharge more than 24 hours after such arrival, shall for each offence, incur a penalty not exceeding thirty pounds.

c. Every person who wilfully destroys or mutilates, or renders illegible any entry in any Official Log Book, or who wilfully makes or assists in making or procures to be made any false or fraudulent entry or omission in any such Log Book, shall, for each offence be deemed guilty of a misdemeanour.

5. The Master, Owner, or any of the crew, of any British ship shall transmit or deliver the Official Log Book for the preceding half-year to some Superintendent in the United Kingdom. In the case of Foreign going ships within 48 hours after the ships arrival at her final port of destination in the United Kingdom.

6. The following are the entries required by law to be made upon the sixth, seventh, and eighth pages of the form—

a. Conviction of any Member of Crew and Punishment. (*Sect.* 240 *of M. S. Act*, 1894.)

b. Offence committed by member of crew for which it is intended to prosecute or enforce a forfeiture, or to exact a fine, together with such statement concerning the reading over such entry, and concerning the reply (if any) made to the charge as hereinbefore required. (*Sect.* 240 *of M. S. Act*, 1894.)

c. Offence for which punishment has been inflicted on board, and the punishment inflicted. (*Sect.* 240 *of M. S. Act*, 1894.)

d. Illness or injury that has happened to any Member of crew, the nature thereof, and the medical treatment adopted (if any). (*Sect.* 240 *of M. S. Act*, 1894.)

e. Marriage that has taken place on board, the names and ages of the parties. (*Sect.* 240 *of M. S. Act*, 1894.)

f. Amount of wages due to any seaman who has entered His Majesty's Service during the voyage. (*Sect.* 240 *of M. S. Act*, 1894.)

g. Wages due to any seaman or apprentice who has died during the voyage, and the gross amount of all deductions to be made therefrom. (*Sect.* 240 *of M. S. Act*, 1894.)

h. Statement of the amount of money and description of the effects left by any seaman or apprentice who has died during the voyage, including a statement of each article sold and the sum received for it. (*Sect.* 240 *of M. S. Act*, 1894.)

i. Collisions with any other ship, and the circumstances under which the same occurred. (*Sections* 240 and 423 *of M. S. Act*, 1894.)

j. Change of Masters—List of documents handed to new master. (*Sect.* 258 *of M. S. Act*, 1894.)

7. On every occasion of the Vessel proceeding to sea, the Master is required, under a penalty of £20, to enter in the Official Log Book the ship's draught of water.

8. Every Birth and Death happening on board is to be entered in accordance with the Directions upon pages 4 and 5.

Q. Where is the ship to be marked so as to show her draught?

Ans. On her stem and on her stern post, in Roman capitals, or figures six inches in length.

Q. The Merchant Shipping Act requires another entry to be made, what is it?

Ans. The amount of clear side.

Q. Where are you to measure the clear side?

Ans. From the lowest part of the upper side of the deck.

Q. How do you measure it?

Ans. Measure from the top of the rail to the water outside, and from the top of the rail to the deck inboard; the difference is the amount of the clear side.

LOSS OF BOWSPRIT, MASTS, &c.

Q. You have sprung your bowsprit, what would you do?

Ans. Keep the ship before the wind under easy sail, and fish it with jib-boom and spare spars, using good chain lashings wedged well tight.

Q. Suppose it is carried away at the knight heads, how would you act?

Ans. I would immediately keep the ship away, reduce sail, take in all head sails, and save everything possible. Secure the foretopmast with a good rope or wire hawser, the middle of the hawser round the mast-head, and each end through the hawse-pipe set up to the windlass; send down foretopgallant and royal yards, also the mast, take in the jib-boom and repair. If the bowsprit cannot be fished, rig out one of the spare spars to replace it, or rig out the jib-boom similar to a billyboy's bowsprit.

Q. The bobstay carries away, what would you do?

Ans. Hard up, and get the ship before the wind, reduce sail to ease the speed; if the bobstay is carried away about the middle, pick up the two parts, shackle them together and set up. If carried away at the stem, get a length of mooring chain, pass each end out through the hawse-pipes and shackle them to the heart where the bobstay sets up; take each part to the windlass and set tight.

Q. Suppose your foreyard was carried away in running so that you could do nothing with it, what would you do?

Ans. Send down the main yard, and then send it up forward.

Q. If you carried away your topmasts, what would you do?

Ans. If they were gone close at the cap, I would scarph them; they would then set the topsails with a single reef.

Q. If they were broken into three or four pieces, what would you do?

Ans. It is most likely I should have one spare spar for a main topmast. I would take the jib-boom for a fore one and the mizzen boom for a mizzen topmast.

Q. If you sprung a lower-mast what would you do?

Ans. I would fish it with spare spars, sending down if necessary the top-gallant and royal masts, to ease it.

Q. Suppose your lower-mast head is getting rotten and the cap is working down; what would you do?

Ans. Make a spanish cap. Take rope or chain and wrap it round and round the lower-mast and top-mast underneath the cap. Fix the ends to a handspike and turn it round and round between the doublings of the masts, till I got the rope or chain fixed hard. Fasten the ends of the handspike to the topmast and wedge till tight.

Q. Suppose the lower or the topmast trestle-trees are weak, what would you do ?

Ans. Place an iron bar through the sheave hole at the heel of the mast; make fast the end of a chain at one end of the bar, pass it over the cap and under the other end of the bar, haul well tight, and pass over the cap again and under the end at the other side. Do this two or three times, and frap the parts tight, between the doublings of the masts.

HEAVY WEIGHTS.

Q. How would you take out a heavy weight on a sailing ship ?

Ans. Rig a pair of sheers over the hatchway in such a manner that one leg is at the port forward corner, and the other at the starboard after corner. Guy these sheers to the hawse pipe forward and the quarter pipe aft. Untruss the main yard and lash it to the mast, having mats to prevent chafe. In the gangway have another pair of sheers for the main yard to lie in, lay it in and lash all together. With the sheers over the hatch lift the weight till it is high enough to clear the rail, then put on the yard arm tackle, ease out; and when clear of the rail, lower away.

Q. If you found the sheer leg giving, what would you do ?

Ans. Bring the strain on the yard-arm tackle.

Q. If the sheer legs are all right, but the yard arm seems to be giving ?

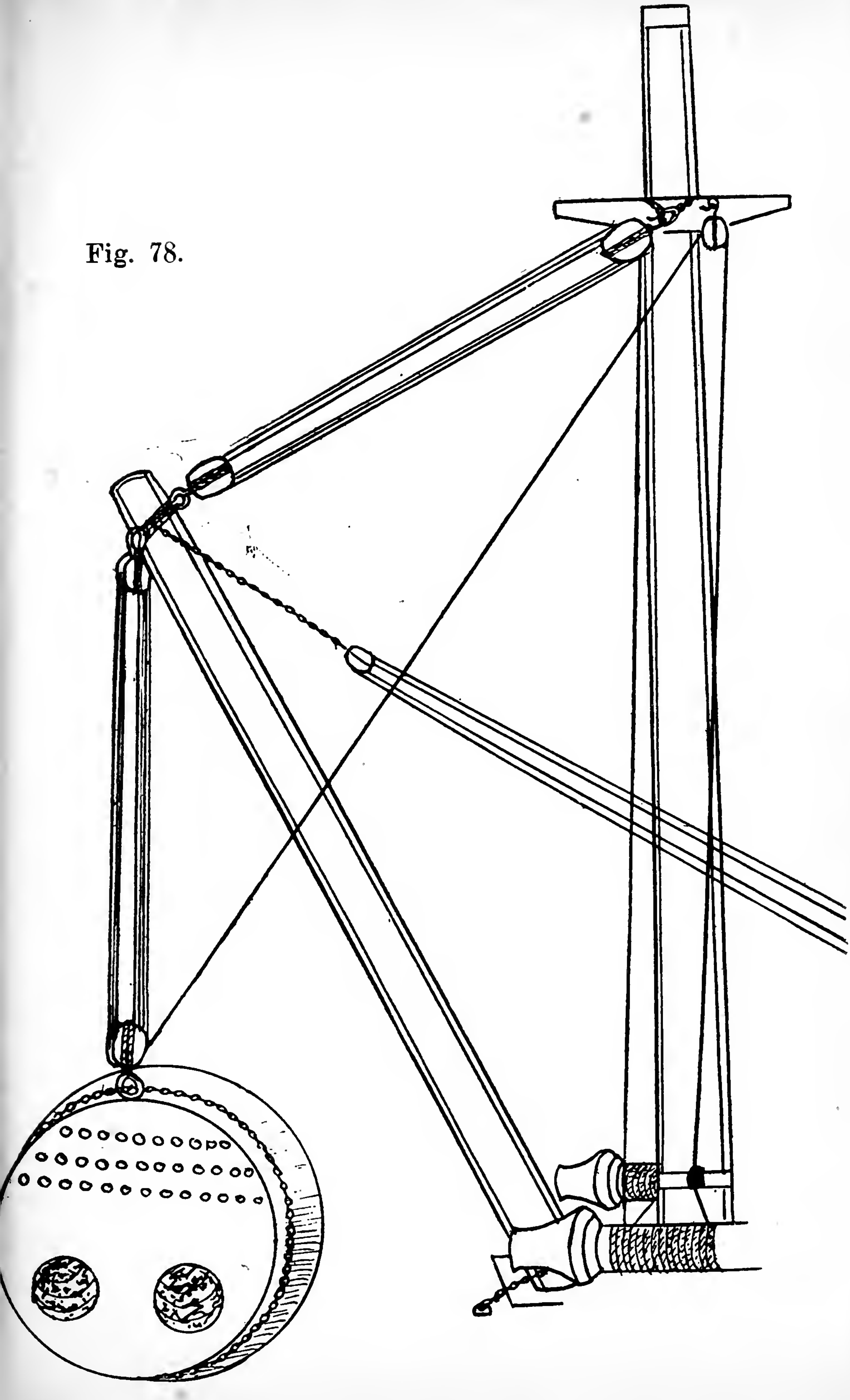
Ans. Haul on the sheer tackle, and get preventer lifts up to the yard-arm.

Note.—Instead of using sheers in the gangway, many use the main yard shored with a derrick, resting on a hard wood shore, over a beam and lashed to a stanchion.

Q. How would you take out a heavy weight in a steamer ?

Ans. Rig a large spar with its heel resting on a wooden

Fig. 78.



shoe, the shoe being a little at one side of the mast above the beam which is shored up from beneath the deck ; rig a good span, a good purchase, good guys, and have preventer stays on the mast.

The majority of modern steamships are fitted with shoes or cups on the decks.

Flexible steel wire is now being used in lieu of chain or Manilla for both heaving purchase and spar. (Fig. 78.)

The hauling part of the purchase between the lower purchase block and the mast head would lead better through a block at the derrick head.

HOW TO MANAGE A STEAMER IN STORMY WEATHER.

When blowing hard with a very heavy sea and you wish to lay her to, reef the main trysail, set it taut out and haul the boom flat amidships, ease the engines down to slow, or just to give her enough way to make her steer, then keep the sea about two or three points on the bow just so that the main trysail will keep full ; this gives the sea a chance to run under her fore shoulder and to keep her bow up ; whereas by keeping her dead head to wind she losses all her way, her canvas will not stand, she falls off into the trough of the sea, and becomes in a dangerous position ; if she lies too badly on one tack bring the sea on the other bow and try that ; if you find she falls off too much into the trough of the sea try to increase the amount of after canvas on the ship, and turn the engines a little faster ; if this fails and you are in such a position that you cannot run her before the wind, then recourse must be had to a sea anchor ; heave her to stern on, or pay the cables out (shallow water.)

A SEA ANCHOR OR SEA DROG SAIL TO LESSEN A STEAMER'S DRIFT, AND KEEP HER OUT OF THE TROUGH OF THE SEA.

This sea anchor should be carried by all steamers, and be ready at a moment's warning. Have two spars cut in lengths about half the beam of your vessel, say she is thirty-six feet beam, the length of the spars should be

Fig. 79.

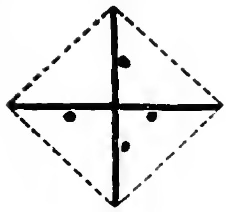
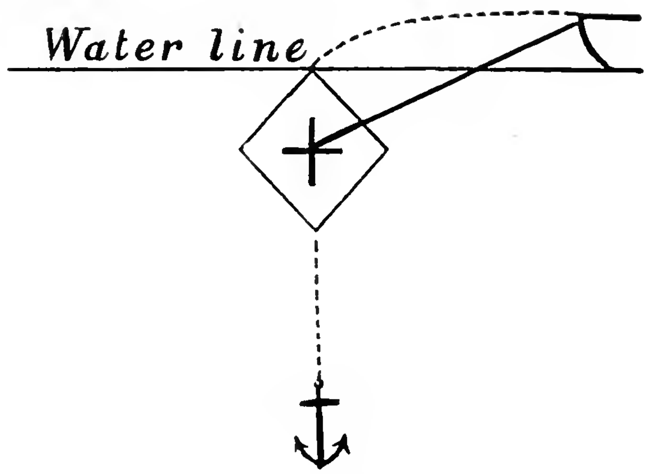


Fig. 80.



eighteen feet, and about nine to ten inches diameter ; a strong iron bolt should be driven through the middle of these spars and secured by a nut and washer, making them like a pair of scissors, so that they can be shut up when not in use and stowed snugly away. When wanted, open them out till they form a cross ; take a runner of $\frac{3}{8}$ths chain and swifter them in that position by hitching the chain round each leg of the cross (see diagram 79) ; make a double chain bridal fast to where the four dôts are placed (this must be good chain), and then you have the skeleton of a kite. On these spars lash a double canvas sail to the chain by eyelet holes worked on the edge of the double sail to the chain you passed from leg to leg of the spars (see diagram 80) ; you then have what is termed a sea kite or drog sail. Pass a hawser through the double bridle and hitch in the same way as you would make a kite string fast. Take a small kedge anchor with about five fathoms of rope and make it fast to one of the spar ends, and call this, for the purpose of explanation, the bottom of the kite ; then to the other end of the same spar make fast a long line, which to trip the kite to get it alongside easily. Having all things now in readiness, drop overboard the kite and kedge anchor before named ; the kite will then assume a vertical position ; pay away the hawser and keep the line attached to the upper end of the kite well slack ; veer out the hawser to about 60 fathoms ; and when this becomes taut it will set the kite to the sea the same as a common kite acts to the wind by its string, the vessel should ride easily by it, and it will stop her drift considerably, as she has a surface of one hundred and sixty-two square feet to drag through the sea, because the kedge keeps it well immersed.

When you are done with it, take the small line you made fast to the top of the kite to the winch and haul in, when the kite will immediately capsize to a horizontal position in the water, and can easily be brought alongside; hook a tackle on the sea anchor and heave it on board.

Note. Some of the large modern steamships when light, will lay much better stern on with the sea anchor out aft.

ANOTHER SEA ANCHOR.

For Small Steamer.

Get a large sail, hitch the end of two wraps along the sail in opposite directions, drop the sail overboard and pay out the warps to their full length, one warp leading out of the warping chock forward, and the other leading through the shoulder pipe.

HOVE TO, STERN ON TO SEA.

In a very strong gale with the sea running high, a Sunderland steamer of about 2000 tons, in ballast, would not steer and was taken charge of by the wind and sea. It was decided to try her stern on to sea; her rudder was made fast and secure amidships and the engines set slow astern. The bow being high out of the water, she soon fell off stern to sea and took up a position with wind and sea about two points on the quarter. As a matter of course the engines raced rather heavily as her stern rose with every sea, but this was of little consequence compared to the benefits derived, as she shipped little or no water, made a little progress and kept steady on one course.

HOVE TO WITH CABLES OUT.

In seas where the depth is comparatively shallow such as the North Sea, a sea anchor need not be used to keep a ship head on.

A better plan is to pay one or both cables out on to the bottom of the sea with plenty of scope; the vessel is not likely to ship much water, she will not lose much ground and what is most important will consume very little coal.

HOW TO TAKE A CAST OF THE LEAD IN HEAVY WEATHER.

Presuming you want a cast of the lead in deep water, say from 90 to 100 fathoms, and it is blowing hard with a heavy sea running, it is a difficulty sometimes not easily got over, especially with a steamer in ballast. Thus, say the lead line is passed well forward, the lead armed, and everything ready for a cast; you ease the engines and stop her way through the water, the lead is then hove, down it goes, but you find before 100 fathoms of line is run out your vessel's bow has blown off the wind, and the lead line trends broad out to windward, consequently no true cast can be got; the best way to get an approximation of the water is by passing the line from right aft of the taffrail to about midships, then heave the lead overboard amidships just before she has lost the last of her way; her bow may blow off then, but her stern remains as it were on a pivot, consequently the line does not trend out to windward, but care must be taken that the line does not foul the propeller. All seamen, however, know that to get a true deep water cast of the lead, with a ship in ballast or high out of water, is one of the most difficult things that can be accomplished with certainty on a dirty night.

With a deep loaded vessel it is different, and comparatively an easy matter; pass the line forward to about the fore rigging, ease the engines to dead slow, and when she losses her way stop her propeller and heave the lead, and in nine cases out of ten a true cast is thus obtainable.

It must be borne in mind in all cases that to get a true cast of the lead, a steamer must be brought head to wind and sea; in stormy weather it is also an important matter that the lead should be primed (even supposing that the nature of the bottom is not required) for by examining the lead when it is brought on board you can at once see if it has touched the bottom, supposing there is a doubt on the matter.

Also, let the seaman remember that *one cast of the lead* may mislead, by its falling at times into fissures at the bottom, so that at least two casts are always indispensible, and a course should never be altered for a single cast, till verified by one or two more.

With a patent lead in shallow water, the ship need not be stopped. (See page 30.)

RESCUING THE CREW OF A DISABLED SHIP.

The best position to place a steamer near a disabled ship is to windward of her, for two reasons, viz. communication is more easily effected, and secondly her wreckage is generally floating away from her and might foul your propeller if you were to leeward of her. Steam your vessel into a position about half a mile dead to windward of the wreck, then put her head to wind, and let her drive down towards the wreck, tending her with the engines to keep her head to wind; when in a good safe berth off her, keep your ship in that position with the engines. Now we will presume that the sea is too heavy to launch a boat, there still remain two ways of communication; first pay a line with a life buoy attached over the stern, which will drive down to the wreck; the disabled ship's crew should make another line fast to the buoy and the crew can be pulled on board in the life buoy one at a time, care being taken that each man is lashed in the buoy. Another plan for getting communication between two ships, in heavy weather, is to take one of the ship's rockets, and make fast to its stick the end of a ball of marline; then flake the marline loose on the deck, and point and fire the rocket, which if it is a good ship's rocket, will carry ordinary marline 250 feet, with a moderate gale, fired before the wind; but if you have a small fishing line it will carry it 300 feet. This has been tried by experiment on shore, and is of great utility.

If you can with safety put out a boat, give your steamer a broad sheer, drop your boat to leeward, and slack her down with a line to the wreck; if this precaution be used two men in the boat is plenty to man her, and these two men should have cork life belts on; one man should tend the line in the boat's bow, and the other tend her with a long steering oar over her stern; and allow no luggage to be placed in the boat till all the lives are saved. Great care is necessary in veering away this boat line; watch the sea well and veer away as circumstances will permit; for if the line is veered away too fast, the boat may turn athwart the sea and capsize; and if such an accident occurs at that time men are apt to lose heart, and the crew of the disabled ship are left to their fate.

It must be borne in mind that if the sea is very heavy a large canvas bag full of small holes and filled with oil put over your vessel's stern during these operations, will greatly smooth the broken sea on the weather side of the wreck.

ANOTHER METHOD.

Distribute oil to leeward and then to windward of the disabled ship, and launch the boat, taking care that all the necessary gear is in the boat, including blue lights if towards night time; the boat will have a fair wind towards the ship, and if likely to breach to, put the drogue out aft. While the crew are being taken off the disabled ship, steam down to leeward and wait of the boat coming back.

TOWING VESSELS.

There are various ways:—

(*a*) If you have a heavy tow, with a strong sea running, take the cable chain of your tow out of one hawse pipe and put it into the other, leaving a bight of about twenty fathoms. In the middle of this bight after it is well parcelled, make fast your towing hawsers, and veer them out to the bare end (Fig. 81); try to keep your vessel with as little way as possible if blowing hard and a strong sea against you, bearing in mind that you had better tow a vessel to a port five hundred miles before the wind, than one hundred miles against the sea and wind, for in the latter case it is ten chances to one you will carry away all your hawsers and not succeed at last. Care must be taken in boarding a derelict ship, for just as you get on board she might be in the act of foundering.

(*b*) Bend a good hawser to the cable of the ship being towed; some prefer two hawsers bent to the cable.

(*c*) Hawser from each ship with cable in the middle (Fig. 82).

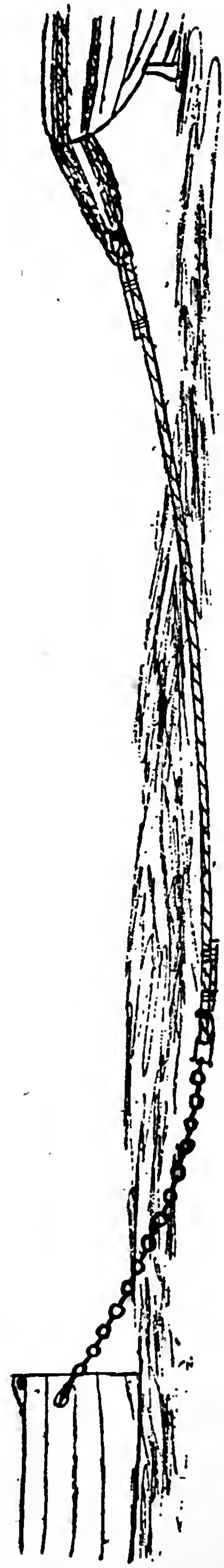
(*d*) Bridle of several parts of manilla or coir, good hawser and cable (Fig. 83).

In all methods of towing, particular attention must be given to the parcelling, and wherever there is any chafing, the parcelling will in all likelihood have to be repaired every day.

Fig. 81.

Fig. 82.

Fig. 83.



HOW TO USE STEAM APPLIANCES IN CASE OF FIRE.

If at sea and the ship takes fire, immediately stop her; if the fire is aft try and keep head to wind, but do not give her any more way than you can help as it increases the draught; if the fire is forward, keep her right before the wind and stop the engines; if any of the hatches are off, batten them down immediately, and block up the mouths of the ventilators. While this is being done, if the seat of the fire cannot be reached, screw on the deck hose, cut a small hole in either the deck or in the hatchway large enough to admit the nozzel of the hose, and keep playing upon the place where you surmise the fire is situated; open the sluices so that the water will find its way into the engine room and be discharged overboard.

If the fire decreases, be very careful in taking the hatches off, as the least air might fan a smouldering fire into a blaze, try to find where the fire originated, and throw any smouldering cargo overboard, if it can be got at.

If the hose is insufficient, connect the steam pipe with the hold under a ood pressure of steam. Do not apply steam and water at the same time, as the water will condense the steam.

If the fire still gains when all the deck hoses or steam pipes are on, get the boats provisioned, and see all clear for saving life. If the vessel is in a position to be run on shore and the fire is gaining rapidly, then run her on shore. Open all sluices and sea cocks to scuttle her, which perhaps will save the ship; this of course is a last resource.

Some of the latest steamships have their holds fitted throughout with steam injectors.

CHEMICAL FIRE APPLIANCES.

Carbonic acid gas injected into the hold is also recommended to put out fire.

Any strong acid (especially muriatic or sulphuric) mixed with chalk or whitening will produce this gas.

These mixed in a water barrel, the resultant gas can be conducted into the hold through a rubber hose fixed to the bung.

The following is an excellent formula:—

For *every* pound of *bi-carbonate of soda* mix *three* ounces of *sulphuric acid.*

COTTON LADEN STEAMERS.

When loading cotton, special precautions have to be taken against fire; tubs of water should be ready at each hatch, hose coupled on and ready for use; a good supply of steam should be ready for steam injections if necessary; spark arresters should be placed over donkey, galley and main funnels.

All paint in the hold should be thoroughly dry and no oil cans should be allowed the stowers for use in the hold to oil their screws.

The hatches have to be put on every night covered with tarpaulins, and the watchman must keep the hatches under constant observation.

BALLAST TANKS.

In the latest construction of ballast tanks there is only one inlet for water, and this inlet is through a valve-box placed in the engine room, which is under the control of the engineers, and all the ballast tank valves lead into this box, which is well marked, viz.—fore hold, main hold, after hold, consequently no water can pass into the tanks unless it comes through the valve-box in the engine room, each tank having a separate pipe leading from it to the valve-box. These pipes are all connected by valves leading to the donkey engine, and are used to pump the water out of the tank.

There are also sounding pipes fitted to the tanks, which ought to be frequently used when the ship is full of cargo.

When filling the tanks great care should be taken that they are quite full, for if they are not completely filled up, it causes the ship to roll heavily, and puts great strain upon the tank top. This is easily known by keeping the sounding pipe cover off, for when the tank is nearly full, the water will commence to fly several feet above the deck, but will gradually subside till the water in the sounding pipe is up to the level of the deck, when the tank will be quite full.

HOW TO CALCULATE THE CAPACITY OF A BUNKER OR HOLD.

Multiply the length by the breadth and by the depth, will give the cubic capacity of the bunker or hold, providing the bunker or hold is a square or oblong.

Note.—Should the bunker or hold be neither square nor oblong, the mean breadth, mean depth, and mean length will have to be taken.

A ton of Welsh coal = 40 cubic feet, Newcastle coal = 43 cubic feet, and bunker space allowing for bad trimming = 45 cubic feet.

In finding the amount of coal a bunker will hold, divide the cubic capacity by 45.

EXAMPLE.—A bunker is 12 feet long, 40 feet broad, and 18 feet in depth; find the amount of coal the bunker will hold.

```
Length     12
Breadth    40
          ----
          480
Depth      18
          ----
         3840
         480
         ----
      45)8640(192 tons
         45
         ---
         414
         405
         ---
          90
          90
          --
```

HOW TO CALCULATE A FREIGHT.

Multiply the quantity of cargo in the ship by the rate of freight, will give the total freight a ship would earn.

EXAMPLE.—What freight would a ship earn carrying 2,600 tons at the rate of 6s. 3d. per ton?

2,600 tons × 6s. 3d. = 16.250s. = £812 10s. freight.

HOW TO CALCULATE COMMISSION.

Multiply the total freight by the rate of commission and divide by 100.

EXAMPLE.—What would be the commission at $2\frac{1}{2}$ per cent. on £1,800 freight.

$$\text{As } £100 : £1{,}800 :: £2\tfrac{1}{2} : x$$

$$\begin{array}{r} 2\tfrac{1}{2} \\ \hline 3{,}600 \\ 900 \\ \hline 100)4{,}500(£45 \text{ commission.} \\ 4{,}500 \\ \hline \end{array}$$

A CUBIC FOOT OF

Fresh water weighs	- - -	$62\frac{1}{2}$ lbs.
Sea ,, ,,	- - -	64 ,,
Oil ,,	- - -	57 ,,

Any liquid = $6\frac{1}{2}$ gallons.

A GALLON OF

Fresh water	= 10 lbs.
Sea ,,	= $10\frac{1}{4}$,,
Oil	= 9·3 ,,

IN DRY DOCK.

When about to dock be careful that she is on an even keel and has no list either way, for if this is attended to she will take on the blocks very readily and easily;

be sure the holds are dry and no water in the engine room bilges. It is generally the custom to knock a rivet out in each water-tight compartment near the keel, so that the tanks may run dry. Examine the fore and aft peaks well, as rust and dirt are mostly found collected in these places; examine well the lower rudder gudgeons, and the boss and keys of the propeller, and also the sea cocks and valves that are under water when afloat.

SHIFTING PROPELLER FROM ONE SHIP TO ANOTHER.

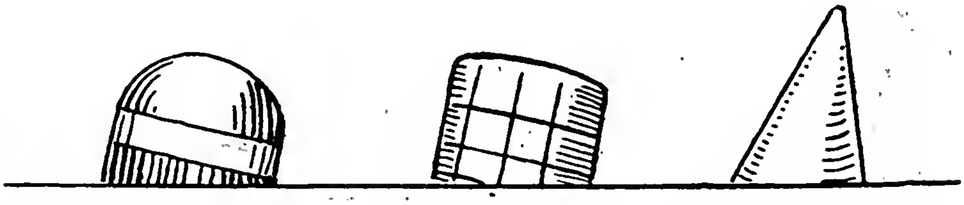
Hang the propeller with quarter tackles hooked to the shackles under the counter or to chains over the quarters, haul in the tail end shaft, lash the other ship's purchase to the propeller, slack away on the outer tackle and heave on the inner, the other ship will take it from you.

If the propeller has to go into a lighter, slack away on the outer tackle, and heave on the inner until the inner tackle has the whole weight of the propeller, then lower away into the lighter.

SYSTEM OF BUOYAGE.

Starboard hand buoys are conical, and painted one colour.

Port hand buoys are can, and painted two colours, or a different colour to the starboard hand buoys.



Middle Ground. Port Hand. Starboard Hand.

Fig. 84.

Middle ground buoys are spherical, and have horizontal white rings painted round them.

UNIFORM SYSTEM OF BUOYAGE.

The mariner when approaching the coast must determine his position on the chart, and must note the direction of the main stream of flood tide.

The term Starboard hand shall denote that side which would be on the right hand of the mariner either going with the main stream of flood or entering a harbour river or estuary from seaward; the term Port hand shall denote the left hand of the mariner under the same circumstances.

Buoys showing the pointed top of a cone above water shall be called Conical, and shall always be Starboard hand buoys as above defined.

Buoys showing a flat top above water shall be called Can, and shall always be Port hand buoys as above defined.

Buoys showing a domed top above water shall be called Spherical, and shall mark the ends of middle grounds.

Buoys having a tall central structure on a broad base shall be called Pillar buoys, and like other spherical buoys, such as Bell buoys, Gas buoys, Automatic sounding buoys, etc., shall be placed to mark special positions either on the coast or in the approaches to harbours, etc.

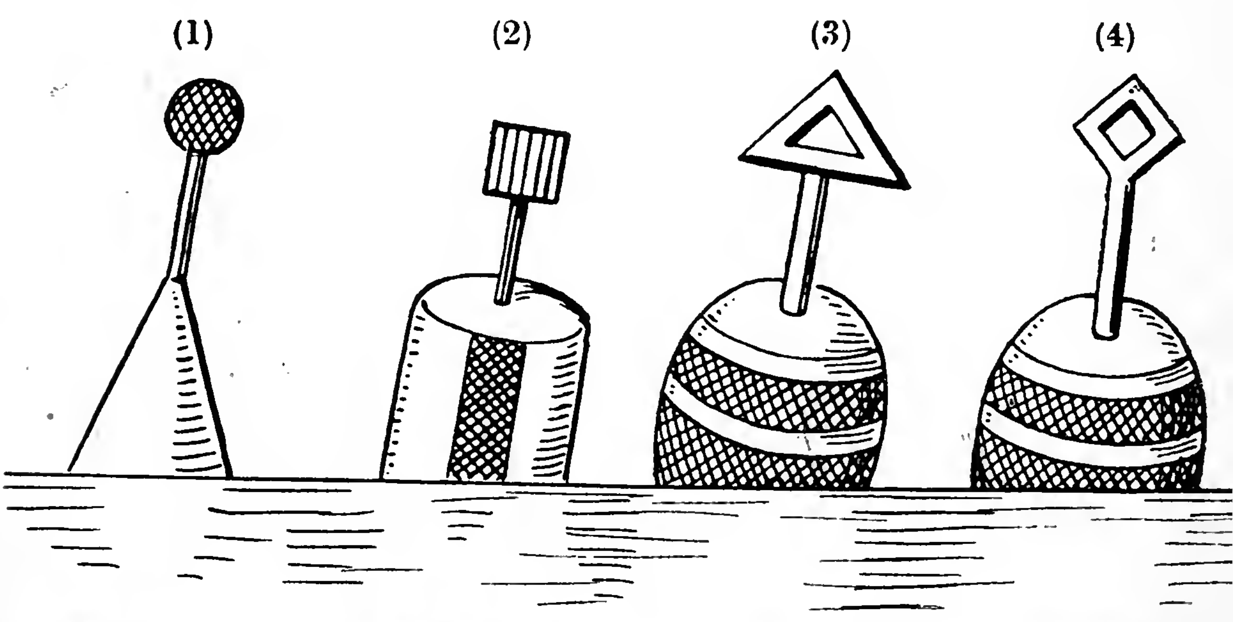


Fig. 85.

Buoys showing only a mast above water shall be called Spar buoys.

Starboard hand buoys shall always be painted in one colour only.

Port hand buoys shall be painted of another characteristic colour, either single or parti-colour.

Spherical buoys at the ends of middle grounds shall always be distinguished by horizontal stripes of white colour.

Surmounting beacons such as staff and globe, etc., shall always be painted of one dark colour.

Staff and globe shall only be used on Starboard hand buoys (1, Fig. 85); Staff and Cage on Port hand (2); Diamonds at the outer ends of middle ground (4), and Triangles at the inner ends (3).

System of Buoyage in use by the NORTHERN LIGHTHOUSE COMMISSIONERS.

Entering port, etc., from seaward—*Red* buoys must be left on the starboard, and black buoys on the port side, passing in.

Buoys coloured *red* and black are placed on detached dangers, and may be passed on either side.

General.

All buoys have their names painted on them.

Fairway buoys are plainly marked.

The figures following the colour of the buoys indicate the depth of water in feet in which they lie at low water spring tides.

CARGO OF GAS COAL.

Keep the ventilators well trimmed, take a few hatches off during the day in fine weather, and test the temperature daily with a thermometer lowered down a tube that leads to the bottom of the ship through the cargo.

OIL TANKS.

Be sure and take no naked lights into the tanks, use electric or safety lamps. When cleaning the tanks fill them with steam, then wipe them down with wads. When filling the tanks with oil do not run them up to the top of the expansion tank, as allowance has to be made for the oil expanding.

COLLISIONS.

Ascertain the other ship's name and port of registry, render all the assistance you possibly can, he must do the same to you. A ship wilfully leaving another in distress after collision will be held in default.

LYING WITH BOTH ANCHORS OUT IN A TIDE WAY.

Leave orders before going below to be called about an hour before slack water. Suppose you were lying at slack water with a turn in the cables, no wind, no steam; you want to make sure of the ship taking the turn out when she turns round. Run a small kedge away from the opposite quarter you want the tide to catch her under, heave on the kedge rope and place the ship in position, the tide will do the rest.

TAKING A STEAMSHIP FROM ALONGSIDE A QUAY.

Get a spring from the inside bow leading aft, and go slowly ahead on the engines; her bow will be drawn in towards the quay and her stern off. When the stern is far enough off, come astern.

Suppose the wind and tide to be ahead. Get a spring from the inside quarter, give her a few turns ahead and take in the slack of the spring; hard over the helm, slack off the head ropes and go off head first, holding on to the spring until far enough off.

Suppose the wind and tide to be aft. Get a spring from the inside bow, and go off stern first.

LOADING A SHIP IN SHALLOW WATER.

Be careful not to get too much cargo in either end, keep the ship upright, and sound round the ship to ascertain if on the ground.

GRAIN CARGOES.

A ship carrying grain in bulk will have to be divided into compartments by means of fore and aft shifting boards, and athwartship bulkheads securely shored from the side of the ship, and grain tight from bottom of hold to deck; the 'tween decks will have properly constructed feeders to feed the lower hold.

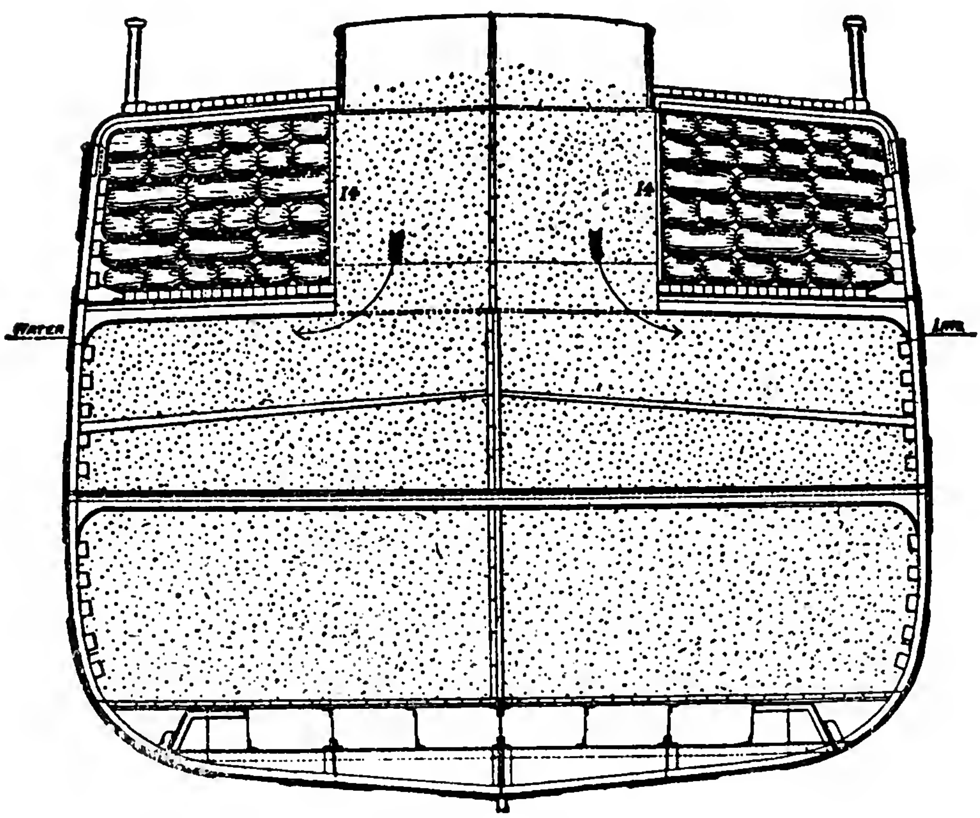


Fig. 86.

THE LAW ON "CARRIAGE OF GRAIN," 1894.

Q. When will this law apply to your ship?

Ans. When she loads with grain in the Black Sea or the Mediterranean, and is bound outside the Straits of Gibraltar; or if she loads grain on the Coast of North America.

Q. What bulk grain may be carried between the decks?

Ans. Between the decks, or if the ship has more than two decks, between the main and upper decks, only such grain in bulk as may be necessary for feeding the cargo in the hold, and this grain must be carried in properly constructed feeders.

Q. What does the expression "ship laden with grain cargo" mean?

Ans. When the cargo of grain consists of more than one-third of the registered tonnage, reckoning by capacity of 100 cubic feet for each ton of registered tonnage; or reckoning by weight, at the rate of two tons weight for each ton of registered tonnage.

Q. What rule is laid down for ships that have not properly constructed feeders?

Ans. That *not less* than one fourth of the grain carried in the hold or compartment (as the case may be) *shall be in bags*, supported on suitable platforms laid upon the grain in bulk.

Q. There are certain exceptions to this. State them.

Ans. 1. To oats or cotton seed.

2. To sailing ships of less than 400 tons registered tonnage, if not engaged in the Atlantic trade.

3. To a ship in the Mediterranean or Black Sea, if the ship is divided into compartments by substantial transverse partitions, and is fitted with longitudinal bulkheads or proper shifting boards, and if the ship does not carry more than one-fourth of the grain cargo, and not more than 1,500 quarters in any one compartment or division, and that each division of the lower hold is fitted with properly constructed feeders from the between decks.

4. If the grain is only one-half of the whole cargo the rest being cotton, wool, etc., or other suitable cargo, so stowed as to prevent the grain shifting.

Q. Must shifting boards be used?

Ans. Yes, whether the grain is in bulk or in bags, unless you have a properly constructed longitudinal bulkhead.

Q. Where are these shifting boards to be placed?

Ans. From deck to deck, or from deck to keelson, fore and aft, and must be properly secured; and if the grain is in bulk, must be fitted grain-tight with proper fittings between the beams.

Q. What kind of boards should they be?

Ans. 3-inch deals.

Q. How are these shifting boards secured?

Ans. Some ships have single stanchions, with a hook for the boards to fit into; but in most cases the stanchions are double, and the boards between them.

Q. What are the three things to be seen to in loading grain?

Ans. That it is properly stowed, trimmed and secured.

Q. Are there any other regulations allowed by the Board of Trade relating to grain cargoes?

Ans. Yes. The Mediterranean and Black Sea, New York, New Orleans, Mobile, San Francisco, and Montreal regulations, are approved by the Board of Trade.

MEDITERRANEAN & BLACK SEA. REGULATIONS APPROVED BY THE BOARD OF TRADE.

Whereas it is provided by section 453 of the Merchant Shipping Act, 1894, that "Where a British ship "laden with a grain cargo at any port in the Mediterranean or Black Sea is bound to ports outside the "Straits of Gibraltar, or where a British ship is laden "with a grain cargo on the coast of North America, "the precautions to prevent the grain cargo from "shifting, set out in the Eighteenth Schedule to this "Act, shall be adopted, unless the ship is loaded in "accordance with regulations for the time being ap"proved by the Board of Trade."

Now, therefore, the Board of Trade approve the following regulations, viz.:—

1. In the case of single-decked ships loading a grain cargo at a port in the Mediterranean or Black Sea where no provision is made for feeding the hold, and where, according to the requirements of the Eighteenth Schedule of the said Act, one fourth of the grain carried in any one compartment, bin, or division must be in bags, the Board of Trade have approved a regulation that the whole fourth, or any part of the fourth, of the compartment, bin, or division which would, according to the requirements aforesaid, be stowed with grain in bags, may in lieu thereof be stowed with bales of cotton, bales of grass, or bags of flour, or other suitable cargo; provided always that the substituted cargo be supported on suitable platforms laid on the grain in bulk and be so stowed as to prevent the grain from shifting.

2. In the case of ships having two decks, oats, cotton seed, or barley may be carried in bulk in the tween decks, provided that—

(*a*) Grain-tight feeders be fitted from the lower hold through the hatches to the uppermost deck; such feeders to contain not more than six per cent. and not less than three per cent. of the quantity carried in the hold or compartment they feed. These feeders must not interfere with or decrease in any way the two per cent. which is required to feed the grain carried in the 'tween decks.

Or (in lieu of the regulation contained in the paragraph (*a*) above) may be substituted the following:—

(*b*) That the between deck hatches shall not at any time be put on; and

(*c*) That strakes of the deck be lifted, or if the deck is an iron deck, sufficient openings be made through the deck in the wings, which with the open hatches shall admit of the cargo in the between decks feeding the lower hold.

The regulations contained below shall also be observed whether the ship is loaded under the regulation contained in paragraph (*a*) above, or in accordance with the regulations contained in the paragraphs (*b*) and (*c*) above; that is to say,

(*d*) There shall be longitudinal grain-tight shifting boards in accordance with Clause 3 of the Eighteenth Schedule of the said Act, and the grain shall be properly stowed, trimmed and secured, as required by Clause 4 of the said Schedule.

(*e*) Feeders shall be fitted to feed the grain carried in the between decks, such feeders to contain not less than two per cent. of the compartments they feed. If strakes of the deck be lifted, or sufficient openings are left to enable the grain in the 'tween decks to feed the lower hold, then it is obvious that the feeders must contain at least two per cent. of the compartments they feed, *i.e.*, the 'tween decks, plus the lower hold.

(*f*) The space in the 'tween decks in which the grain in bulk is carried shall be bounded at each end by grain-tight transverse bulkheads or partitions extending from deck to deck.

(*g*) The ship shall not be overloaded.

3. If at any time it should appear to the Board of Trade that the above regulations or any of them insufficiently provide for the safety of the ship, and should therefore in their opinion be revoked and withdrawn; or that they need alteration; the Board of Trade will revoke, withdraw, or alter them accordingly.

PLANS FOR VESSELS LOADING GRAIN IN THE MEDITERRANEAN AND BLACK SEA.

Applications for exemption from the Mediterranean and Black Sea regulations may be sent to the Principal Ship Surveyor of the Board of Trade. Drawings showing the Owners' intentions with regard to the stowage of grain and clearly indicating—capacity of holds, position of feeders, bulkheads, portable fittings, etc., have to be submitted, and if satisfactory to the Grain Committee, an approved plan of Loading is issued.

MISCELLANEOUS QUESTIONS.

Q. Riding in a gale, ship straining at cables, what would you do to ease the windlass?

Ans. Get a spring on to both cables, make fast at the fore side at windlass and lead them well aft, having an equal strain on windlass and bitts or wherever the springs are fast to.

Q. Steaming head to wind and sea, fore hatch stove in, what would you do?

Ans. Ease the ship down or put her before the wind, then get the hatch secured.

Q. What would you do if the forecastle was on fire?

Ans. Get the ship before the wind, then the wind will stop the fire from spreading aft, if got at in time. (See page 203.)

Q. How would you stow a full cargo of 5,000 tons in casks, no 'tween decks?

Ans. A platform or temporary 'tween deck will have to be built, as the lower tier would never bear the weight of the upper tiers.

Q. You part your cable, how would you sweep for your anchor?

Ans. Get two boats, and drag a lead line (weighted in the middle) over the ground; the line will catch the fluke of the anchor, then slide a running bowline down the two parts, after they are brought together.

Q. What would you do going alongside a quay with a strong wind blowing right on?

Ans. Drop the anchor on the bottom, and dredge her alongside.

Q. You are holed just below the water in harbour, what would you do?

Ans. Give the ship a list, by shifting cargo, filling boats with water, running a trimming tank up, or filling one boiler whilst emptying another.

Q. How would you heave your anchor up, with a messenger windlass, No. 1 winch broke down?

Ans. Lengthen the messenger, and connect it with No. 2 winch.

Q. Ship ashore with decks listed towards the sea, what would you do?

Ans. Try and get her listed with her decks towards the shore.

Q. Lying in roadstead, captain on shore, coming on to blow, what would you do in a steamship?

Ans. Order steam, pay out more chain and let go the second anchor; if it is necessary to slip, buoy the cables and steam to sea.

Q. Getting underway in a steamship, you are afraid of the anchor going through the bow, on account of the heavy swell; what would you do?

Ans. Leave the anchor hanging under the forefoot, and steam to sea; when far enough out, put the ship stern on to the sea, and take the anchor on board.

Q. What signals do you show when loading gunpowder?

Ans. Red flag by day, red light at night.

Q. Where would you stow gunpowder?

Ans. In a properly constructed magazine, near or in the hatchway.

Q. What would you do after cleaning limbers?

Ans. Disinfect them with lime.

Q. You are steaming up or down a river, with a six knot tide behind you; how would you bring the ship to?

Ans. Drop the anchor on the bottom and come astern; when head to tide, slack away the cable.

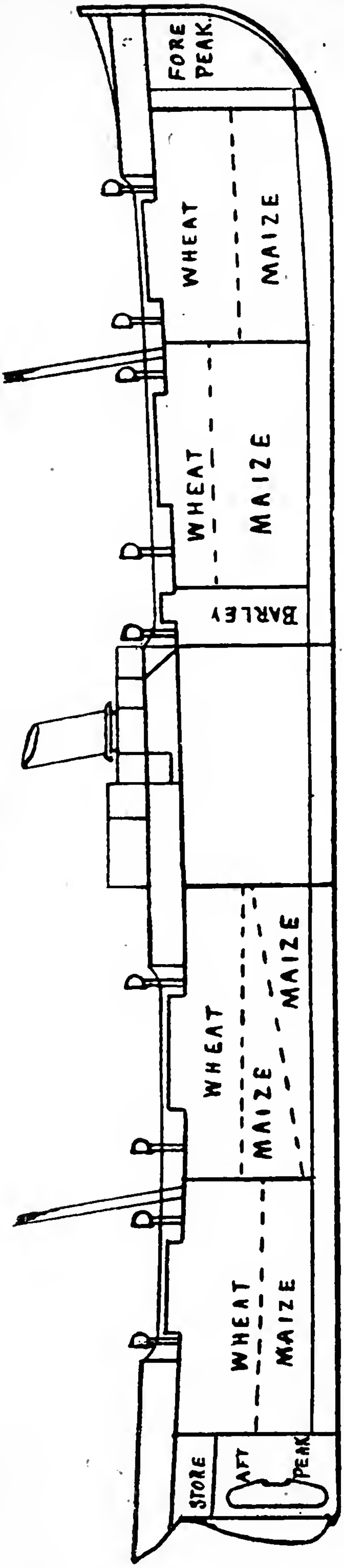


Fig. 87.

Q. You are loading general cargo; how would you tell where the different kinds of goods were stowed?

Ans. By stating them on a plan of the hold (Fig. 87).

Q. You have lost your propeller (light ship), how would you ship the spare one in an open roadstead or at sea?

Ans. Heave the propeller out of the hold and swing it over the rail on to the side of the ship; overhaul a good purchase from aft along the ship's side and bend on to the propeller; make fast another purchase from forward; heave on the after purchase and slack away on the forward one until the propeller is far enough aft to be slung with the quarter tackles. Pump out the after ballast tanks, keep the fore ones full, and run sufficient water into the fore hold to raise the after end with the stern tube clear of the sea. Place the propeller into position with the quarter tackles, having the boss fair over the stern tube; slide out of the tail end shaft, key it and screw up. (See diagram further on.)

Q. How would you get a heavy weight from under the hatch to the bulkhead?

Ans. Place it on skids, rollers, or stokehold plates; heave on a good purchase and assist the purchase with screw-jacks and crowbars.

Q. How would you moor a ship between two buoys, wind and tide ahead?

Ans. Keep the ship head on to tide with just sufficient way on her to stem the tide; get close to the weather buoy and make fast a bow rope, heave taut and reeve a ring rope from the ship through the ring of the buoy and bend on the cable; heave out the cable to the buoy, and shackle to the ring; heave the cable tight with the windlass, then get out the after moorings.

Q. You are lying three miles off shore, a workman is severely injured, what would you do?

Ans. Lose no time in getting him on shore; if he cannot be moved, get a doctor off as quickly as possible, and in the meantime, place him in the most comfortable position and render whatever first aid is necessary. The particulars will have to be entered in the Official Log.

Q. What would you be particular about regarding ship's davits?

Ans. Have the boats frequently swung out to keep them in working order. Boat drill is now compulsory and has to be notified in the Official Log.

Q. How would you get out a boat in a heavy sea?

Ans. Bend a good line to the bow of the boat, lead it well forward outside everything on the side of the ship, and make fast; haul tight both tackle falls, swing out the forward davit, then the after; place two hands in the boat and lower away; unhook both tackles immediately the boat takes the water.

Q. Prepare steamer for light passage?

Ans. Have everything securely lashed, after peak tank and all other tanks full.

Some ships on a light passage plug the scuppers and flood the after deck; others flood the after hold up to the tunnel top, shoring down the ceiling or taking it entirely up.

Q. Strong tide, get a steamer into dry dock?

Ans. Get the ship's stern on to tide, below the dock if it be flood tide, and above the dock if it be ebb. Heave on the bow rope and slack away on the after one, placing the ship heading into the dock; the stern rope will keep the ship in position as she is hove into the dock.

In large ships it is customary to have the assistance of one or two tugs, and to wait until slack water.

Q. You are discharging with six or seven whips from the gaff; the gaff carries away, what will you do?

Ans. Rig a strong span from one mast to the other, and replace the whips from the span.

Q. How often should you clean fresh water tanks?

Ans. If possible, every six months; they should always have a coating of cement wash or lime before filling up.

Q. Prepare a hold for flour after discharging paraffin?

Ans. Steam the hold well, then dry inside with wads; rig wind-sails and trim ventilators.

A large number of the modern steamships are fitted throughout with steam injectors.

Q. You are lying on a shore, the tide is rising and the ship will not float, she is stuck in the mud; what will you do?

Ans. Shake the ship as much as possible, by going ahead and astern with the engines, heaving on warps on each side; do everything possible to vibrate the ship.

If you are going alongside a quay where you expect your ship is likely to stick (some berths are noted for this), pass a couple of chains under the bottom of your vessel, and when the tide makes heave on these chains, which will break the mud and allow the water to flow under the ship.

Q. You are loading cargo in the fore hatch; what effect will this have on the ship?

Ans. For every foot she sinks forward, she will rise about $4\frac{1}{2}$ inches at the after end.

Q. Ship aground with only her fore foot resting on a rock, how would you get her off?

Ans. Run an anchor away from each quarter with good warps or steel hawsers made fast to each anchor; heave away on both hawsers; if she does not move, heave first on one and then on the other.

It may be necessary to lighten or jettison cargo forward, and in a steamship the engines will in addition be set full speed astern.

Q. One of the chain plates of the lower rigging carries away, what would you do?

Ans. Get a short length of chain or wire and make both ends fast to eye bolts, ring bolts, scuppers, or anything strong enough in the vicinity of the chain plate that has been broken; then set up the shroud to the chain or wire.

Q. In loading, what effect would too much dead-weight cargo have on the ship (*a*) amidships, (*b*) at both ends?

Ans. (*a*) The ship would sag or droop in the middle. (*b*) The ship would hog or droop at both ends.

Q. You are in a sailing ship at the entrance of a narrow river, it is flood tide and the wind is blowing down the river, get the ship into the harbour?

Ans. Lay the vessel athwart wind and tide at the entrance of the river with only the topsails set, shiver the yards; the ship will then drive up with the tide, backing and filling the yards as occasion requires.

Q. Heaving an anchor up, the hawse pipe carries away, what would you do?

Ans. Unshackle at the first shackle abaft the windlass, hang the cable with a good warp, unreeve out of the broken hawse pipe and reeve through the other; heave away with the other side of the windlass.

Q. How would you take a turn out of the cables (clearing hawse)?

Ans. Lash the two cables together as low down as necessary, unshackle the one I am not riding to, and pay it out of the hawse pipe, take the turns out; pass it up through the hawse pipe again and shackle on.

Q. How should a ship's cable be marked to indicate the different shackles?

Ans. Piece of wire at the first studded link abaft the 15 fathoms shackle; wire at the second studded link abaft the 30 fathoms shackle; third studded link abaft 45 fathoms; fourth abaft 60 fathoms; fifth abaft 75 fathoms, etc.

Q. You are moored to buoys a short distance from the shore, tide ahead, how would you get your ship alongside the quay?

Ans. Get a warp from the inside bow to the quay (well ahead), take in the stern moorings, make a rope fast to the buoy from the outside bow, take in the bow moorings; heave on the shore rope and stack away on the buoy rope, steadying her alongside with the helm.

Q. The buoy rope parts, what would you do?

Ans. Drop the anchor and dredge her alongside.

Q. A lightship fires a gun and hoists J. D. what would you do?

Ans. I would stop the ship or haul her out, as this is a signal indicating I am standing into danger.

Q. What does a rudder rest on?

Ans. The lower pintle rests on a convex steel bearing in a socket at the heel of the stern post.

Q. How is a rudder head steadied?

Ans. The rudder head passes through a stuffing box at the uppermost deck, which is fitted with packing glands to both steady the rudder head and stop any water in the rudder trunk coming through to the uppermost deck.

Q. What are frames?

Ans. Stiffeners to stiffen the shell of an iron ship; they are mostly arranged transversely, sometimes longitudinally.

Q. What are stringers?

Ans. Fore and aft stiffeners to stiffen the frames.

Q. What are floors?

Ans. Deep iron plates across the bottom of the ship, usually at every frame; their lower edges are riveted to the frames and their upper edges to the reverse frames.

The ceiling in an ordinary ship and the tank-top in a cellular bottom are connected to the reverse frames.

Q. What are breasthooks?

Ans. Horizontal plates right forward abaft the stem, to connect the sides of an iron or steel vessel. They are called crutches at the after end.

Q. What are the functions of beams?

Ans. Transverse ties, to keep the sides of the vessel in their relative positions and to support the decks.

Q. What are functions of pillars or stanchions?

Ans. Vertical ties, to keep the decks and bottom of the ship in their relative positions and to support the beams and the heavy weights resting thereon.

STRENGTH OF ROPES.

Breaking Strain, etc.

(Hemp or Manilla.)

Square the circumference and divide by three for the breaking strain, in tons; by four for the proof strain; by six for the working strain.

Example:—

$$\begin{array}{r l} 6 & \text{inches in circumference.} \\ 6 & \\ \hline 3)36 & \\ \hline 12 & \text{Tons} = \text{Breaking strain.} \\ \hline \end{array}$$

(Steel Flexible Rope.)

Square the circumference and multiply by two.

Weight a Rope will Lift when Rove as a Tackle.

Multiply the weight the rope is capable of suspending by the number of parts at the movable block, and subtract one-fourth of this for resistance.

Relative Strength of Chain and Rope.

Consider the proportional strength to be ten to one, using the diameter of the chain and the ircumference of the rope. Half-inch chain will replace five inch rope.

To Calculate the Weight of Rope.

Three strand, hawser-laid, 25 thread yarn tarred. Multiply the square of the circumference by the length in fathoms, and divide by 4·24 for the weight in lbs.

The devisor for hempen cables is 4·79.

ADDITIONAL FOR MASTERS.

HOW TO RIG A JURY RUDDER.

Q. If your rudder was carried away what would you do first?

Ans. Bring the ship to the wind by bracing up the after yards, and meeting her with the fore yards as she comes to. Heave her to with just sufficient sail to steady her; if she falls off set some after canvas, and if she comes too close take in after canvas. A ship can be hove to or made to steer by easing head sails, flattening after sails and trimming yards to bring her closer to the wind, and by flattening head sails, easing after sails and trimming yards to keep her from sailing too close.

Q. How would you make a jury rudder (wooden ship)?

Ans. Take a spare topmast, cut it to a sufficient length, bolt lengths of spars to this main piece, each shorter than the last, so as to form the shape of a rudder, then plank it over on both sides diagonally to make it stronger.

Q. How would you get the jury rudder placed?

Ans. Cross the chain around the main piece, about two feet from the heel, and cross another higher up, so that it will come just below the rudder trunk casing. Get a pair of sheers rigged over the hole of the casing, pay out a warp down the trunk, bring the end in over the taffrail by the bight of a line thrown over it, pass this end of the warp through the hole for the tiller, take two half hitches round the standing part and stop the end, pass the other end of the warp through the block at the head of the sheers, and lead it to the winch.

Hang a kedge to the heel and throw all overboard. Heave on the winch till the rudder comes up high enough through the casing; lead the chains at the heel forward to the fore chains, and the upper to the mizzen chains; bring them inboard and set them taut.

Q. If you were within a day or two of your port, would you go to all this trouble?

Ans. No; I would get a long spar out aft, with chain round the outer end to weight it, and a warp or chain middled round the end; the parts brought to blocks at the end of boomkins or outriggers for the purpose; and so inboard to the barrel of the wheel or winch (Fig. 89.)

Q. How would you keep it off the taffrail?

Ans. Suspend it in the crutch of a small pair of sheers aft.

Q. The following is another plan for making a temporary rudder for steamships which has been much approved by many experienced seamen.

Ans. Tow a large spar weighted with chain hanging in short bights, the bights being lashed together with small chain. A chain from each quarter is shackled on to one end of the spar to tow with, allowing just sufficient scope for the counter to clear when she pitches or scends. At the after end of the spar, steel hawsers are fast which lead through blocks at the end of outriggers to the steam winch. These hawsers are passed round the winch so that when the winch is turned, one part is being hove in and the other run out. The after end of the spar can be hove towards either quarter (Figs. 90 and 91.)

Q. Jury rudder (Fig. 88).

Ans. Tow a spar (athwart) with a good steel hawser from each quarter. Have a few turns of chain round the spar to weight it, and a good chain or wire bridle from one end to the other. Bend the ends of the hawser to the bridle so that there will be a short leg at each end of the spar.

The spar tows at right angles to the fore and aft line when an equal strain is on each hawser; but when the hawser is slacked away on one side and hove in on the other, the spar will shoot out on the same quarter as the heaving hawser, drawing the ship's quarter in the direction of the spar; consequently, when the ship's head is required to go to starboard the spar will have to be hove to the port quarter, and to the starboard quarter when altering course to port. One hawser will suffice, the middle round the steam winch and the ends made fast to the bridle. One hawser will also suffice for previous question.

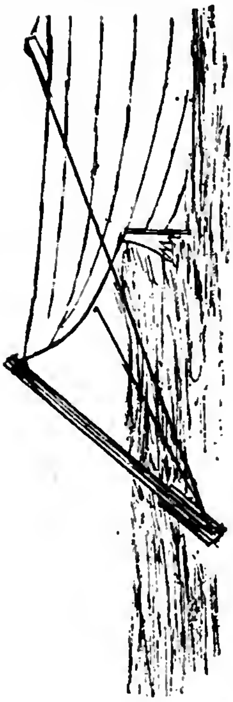


Fig. 89.

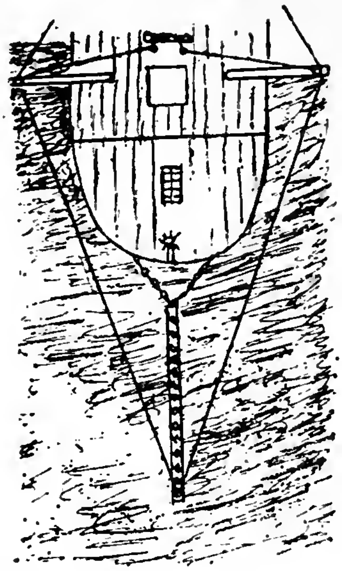


Fig. 91.

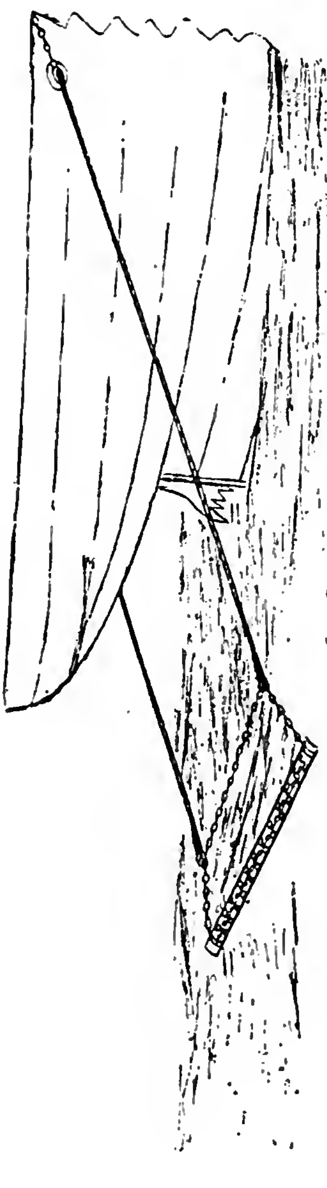


Fig. 88.

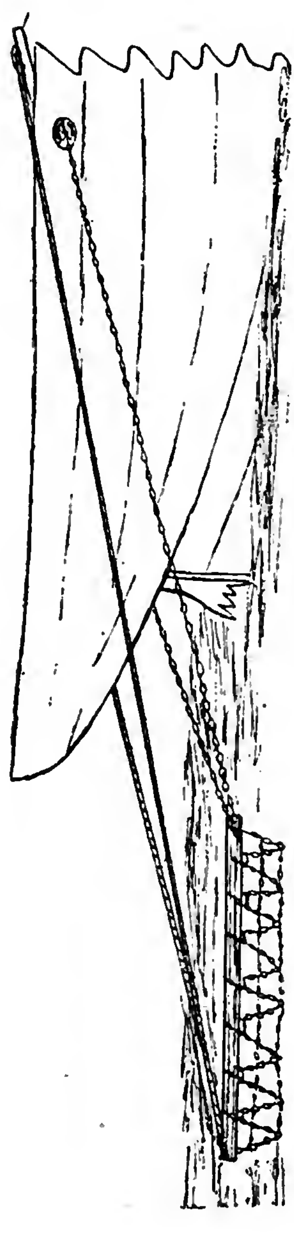


Fig. 90.

SEAMANSHIP.

Q. How would you moor a ship in a bay or roadstead?

Ans. Having come to with a single anchor, I would endeavour to ascertain if the place was attended with any local dangers, such as a heavy swell, or strong sea setting in, or whether the wind was more boisterous from any one point than from others. On ascertaining this I would run out a kedge and warp in the direction I intended to lay the second anchor, which would be in such a place that, when moored, the ship might bear with equal strain on both anchors from the point from which most danger might be apprehended; then haul the ship out by the warp, veering away at the same time the cable of the anchor already down, to the end. If greater scope were required, I would bend on a warp, and veer away sufficient for the purpose, and then let go the other anchor, veering away the cable as the cable of the first anchor was being hove in, until the ship was in a good position between the two anchors.

Q. Is this rule preferable in all places and under all circumstances?

Ans. No; there are places where the land is very high, and covered with snow for the greater part of the year (such as the coast of Anatolia on the south side of the Black Sea, with many other places of the same nature), thereby causing the atmosphere to remain so cold, that although it may be blowing a gale of wind in the offing (where it is much warmer), directly towards the land, yet it no sooner reaches the land than it is repulsed or driven back by coming in contact with the coldness of the land; it will then be succeeded by light airs from the land, and squalls flying about in different directions; and a ship moored in the foregoing manner would be constantly turning round and round, having sometimes her stern and sometimes her beam to the sea, thereby causing her to roll very heavily, and in a manner that might prove very injurious to her, besides stopping all possibility of working cargo.

Q. How would you moor her under such circumstances?

Ans. I would lay the best bower anchor to seaward, say, from the starboard bow, and the other bower or port anchor in a direct line towards the land, at the greatest distance my cables would reach, placing the ship in a good position between the two anchors. I would then have a good rope hawser out of the port quarter, made fast to the in-shore cable, at a short distance from the stern of the vessel, and by keeping this tight the vessel must consequently lay with the head to seaward, under all circumstances, or any change of wind, and will in this manner keep end on to the swell of the sea rolling towards the land. Provided, however, it comes on to blow from the land, or on either beam, very hard, slack down the hawser, and the vessel will instantly swing round head to wind, and is still properly moored.

Q. How would you box-haul a ship? (Turning short round.)

Ans. Put the helm down, haul the mizzen boom amidships, light up the head sheets, and slack the lee-braces, to let her come to; as she comes to the wind, raise tacks and sheets, and haul up the mainsail and brail in the spanker; when she loses her headway, square the after yards, brace the head yards sharp aback, and flatten in the head sheets; the helm being down, will pay her off as she has stern way; as she goes off, keep the after yards lifting and square the head yards, shift the helm; when she gets the wind on the other quarter, haul out the spanker, set the mainsail, and brace the after yards up; as she comes to on the other tack brace up the head yards, and meet her with the helm.

Q. On a lee-shore by standing on, you must go on shore; you can clear the land on the other tack, but it blows hard, with a head swell, and she will not stay; you cannot wear; how would you get on the other tack if you had good anchorage ground?

Ans. I should club-haul her; cock-bill the lee anchor, get a hawser on it for a spring, and lead it to the lee quarter; range the cable and unshackle it abaft the windlass; "*Helm's a-lee;*" raise tacks and sheets as for going in stays; as soon as she loses headway, let go the anchor and when head to wind "*Mainsail haul;*" when certain she will pay off on the other tack, slip the cable, holding on the spring; when the after sails fill, cut the spring, "*Let go and haul;*" trim all to the wind.

Q. If you had no anchorage ground?

Ans. I should box-haul her and let her come round on her heel. (Question 4.)

Q. You are lying to in a gale of wind, and cannot show a bit of canvas, how would you prevent the ship from falling off?

Ans. Roll up a tarpaulin, take it to the mizzen weather rigging, and let it go; the wind will unroll it and keep it firm.

Q. You are scudding, how would you guard against the ship broaching to?

Ans. If scudding under the main topsail and foresail, I would keep the fore topmast staysail set, with the weather sheet hauled flat aft; but if under bare poles, and the ship was likely to broach to, I would haul my fore yards sharp forward to the wind, to meet her. In extreme cases, the bight of a hawser hung over the stern, with a good length of rope, has been found very efficacious.

Q. If your masts were all cut away in a gale, how could you keep her head to the wind and sea?

Ans. By paying out a sea-anchor ahead.

Q. Being totally dismasted, how would you act?

Ans. The nature of such a loss will not admit of any definite instructions being given, so much depending upon the situation of the vessel, and the circumstances connected with it, whether caused by a sudden squall of wind, or from a long and heavy gale; and also whether near the land, or a great distance from it.

Q. What method would you use under these circumstances?

Ans. I should be guided primarily by the nature of the sea, whether running high or comparatively smooth; also by the position of the vessel, as regards her being near the land or having sufficient sea-room. Having sufficient sea-room and comparatively smooth water, I would take time and save as much as possible to rig jury masts fore and aft. In a gale and a strong sea, I would be obliged to cut much away to prevent the hull of the ship being stove, but should, if possible, try to save any spars that were not likely to damage the hull; any that would do I should get up aft to set a staysail or any other small sail, in order to keep the vessel's head to the sea, and with returning fine weather, I would rig the best jury mast I could with such materials as I had saved.

Q. In case of your ship foundering, how would you provide for the safety of your passengers (if any) and the crew?

Ans. If I had passengers, I should on leaving port, tell off men to the different boats, and these men would be made to understand that they formed the permanent crew of the boats to which they were told off. I should occasionally exercise them in getting ready the boats, and make it the duty of each officer daily to see that his boat was in proper order, with everything ready, a plug and also a spare one made fast by lanyard close to each plug hole for immediate use; the rollocks with a lanyard to the foot of each passed through the rollock hole and fast to the inwire or thwart of the boat, so that in an emergency there would be no searching for them; and above all, I would be sure that the boats' crews were trained for each man to look after the proper gear he had to use, so that every man knew his work in case of sudden necessity.

If my boats were lost previous to the catastrophe I should then set about making rafts, by taking three of the longest spars I could get, and forming a triangle of them; then cross these by others and lash them securely together (some prefer to use four stout spars and make the raft square), cross these again by another layer, and so on till the spars are all used. If I had any empty casks, or water casks, or breakers, I would lash them to the undermost layer, and also rail the edges with small spars and ropes.

Q. Name some of the things you would put on the raft.

Ans. Provisions, all the water I possibly could, arms and ammunition, sails and small lines to rig tents to shelter the crew, and a small yard with its sail to help the raft along.

Q. If you were without water in the boats, how could you alleviate thirst?

Ans. By keeping the clothing damp with sea-water.

HEAVING A SHIP DOWN, ETC.

Q. How would you heave a ship down?

Ans. I should first of all clear her of everything not absolutely required; and remembering that a part of my deck will be under water, I should have that part well caulked, I would have the masts fished, and shored from the water-ways by two spars (with tom-shores in the hold under their heels) sheer fashion, well secured at the mast-head, and shores put in against the mast under the deck, to ease the strain on the partners on the under side in heaving down. I would get up as much preventer rigging as necessary; and if the vessel is likely to be difficult to heave down, I would get one or two outriggers out from each mast, taking the lower plank of the bulwark off, so as to rest on the gunwale, with martingales passed round the keel and made securely fast on the side to be hove down; lead stays from the outrigger ends to the mast head; lash the purchase-blocks aloft securely, the eyes of the block strop coming round the mast-head, and lashing on the same side as the block, as nothing can be too well secured in heaving a ship down. After I had got the preventer rigging well and equally set up, I should wedge the shores up till the main strain is taken off the standing rigging, so that all the preventers bear equally with it. I should then endeavour to get a pair of spare pumps to put down the hatchways into the lee bilge, to pump the ship out whilst hove down; but if I could not procure any, I would take the ship's pumps out, and use them for the purpose.

When I had got all ready for heaving down, I would moor her head and stern with an anchor at each end, laid well on the side to be hove out, with the stream chains fast to the anchors. I would pass them under the bottom, and make them securely fast to the side to be hove down, which would keep the ship from closing in on the vessel, lighter, or quay she had to be hove down to; and if I was going to heave down to a ship or lighter, I would moor her with anchors, directly opposite the ones I had laid down, so that the ship or lighter may keep fair in heaving down.

Q. After you had effected the necessary repairs, how would you ease your ship up again?

Ans. I would man the heaving down capstans, and walk them back, so as to ease the ship up regularly without jerking the masts, as lower masts are more liable to be carried away in easing the ship up than in heaving down by the jerks in surging the falls, if you do not walk steadily back with the capstans.

Q. If you had to heave down by another vessel not prepared for the purpose, how would you secure your lower blocks to bear the necessary strain without injury to that vessel?

Ans. If the vessel had hatchways the same distance from one another as the masts of the ship to be hove down, a heavy spar to be secured under the lower deck beams with diagonal shores, would answer for the lower blocks to be lashed to; but if the vessel is much smaller than the ship to be hove down, the most secure method not to injure the vessel is to pass sufficient turns of hawser entirely round the body of the vessel at a proper distance for each of the lower blocks, and pass swifter lashings through the parts of the hawser, outside the gunwale on each side, secured to the exact distance, so that the hawsers may not slip apart by the shape of the vessel in heaving down. In heaving the ship down, if I found her coming down very easily, I should pall the capstans, and have tackles got up to the mast-heads to prevent the ship falling too far over after losing her bearings, as ships of a certain build are liable to do.

Q. Suppose the ship does not rise, what would you have done, before heaving her down, to meet this emergency?

Ans. I would have taken a warp, middled it, and passed it under the ship, so that the bight is on the side to be hove down; then pass the ends through the bight, and so clinch it on the lee side. Then if the ship won't rise, I could parbuckle her up with this warp.

Q. Is there any other way of helping up a ship that will not rise?

Ans. Yes; rig a derrick on the barge, and lift her by her masts.

Q. If you had to heave her down, say two miles from the shore and no barge?

Ans. I would make a raft, moor it well, and weight it as heavily as possible. The lashings for the purchase blocks to go all round the raft.

MANAGEMENT OF A SHIP ON THE STRAND.

Q. Riding at anchor on a lee shore, with no possibility of getting under way, what would you do?

Ans. I would slack both cables out to an end, provided I had sufficient room to do so, and have a good purchase on the cables before the windlass leading well aft. These purchases, set well tight, would greatly ease the strain on the windlass. I would also send down the topgallant yards and masts.

Q. You find the ship is dragging her anchors, how would you act?

Ans. I would let go the stream anchor, with the best hawser fastened to it; send in the jib-boom; send down the lower yards and topmasts; and if, *after due consideration*, I found it to be expedient, I would cut away the lower masts.

Q. Having done all this, still your cables part, and the ship drives on shore, what would you do?

Ans. My first consideration would be the preservation of the lives of all on board, and afterwards as much of the property as possible.

Q. In what manner would you proceed?

Ans. The means necessary for the preservation and recovery of ships stranded do not admit of being limited to definite rules that can be applied to all cases of misfortune, which seldom occur under the same circumstances, are of the same nature, or to the same extent. The size of the vessel, the position in which she lies, the nature of the ground (whether composed of rock, gravel or sand), whether the ship is in ballast or loaded (if loaded, the description of the cargo), and many other circumstances, require the greatest consideration for deciding the means to be adopted, as the urgency of the case may require, independently of the state of the weather, by which the operations must, in a great measure, be directed and influenced. On the entire seaboard of the United Kingdom there are not to be found two neighbouring bays or beaches to which the sea flows with equal force, or to equal depth. The declivities of the shores are more or less acute or precipitous, and the sea, in consequence, is more or less resisted in its approach, and precipitate in its retreat. It would therefore be absurd to prescribe specifically the course to be pursued in the various cases of shipwreck, which alone can be suggested by experience, and will much depend on promptitude, activity, and perseverance for ultimate success.

Q. Suppose your ship is stranded on a sandy beach in the United Kingdom, how would you act?

Ans. Having got on shore as much of the cargo (if any) and tackling of the vessel as possible, I would place them in a store, or any other suitable place, provided such place could be obtained. If not I would rig tents with the ship's sails, and stow the materials therein.

Q. Would you not deliver them over to some agent (who might be on the spot) to take charge of them and see them attended to?

Ans. No; I should have no authority to do so; but as soon as practicable after getting on shore, I would communicate with the owners of the vessel and the owners of the cargo, stating full particulars of every circumstance relating to both the ship and cargo, and retain full power, and hold command over all things connected with the ship and cargo, until I receive a reply, and on receiving it I should most likely be advised how to act, and would act accordingly.

Q. Your orders are to endeavour to get the vessel off, how would you proceed?

Ans. As a general rule I would endeavour to get the vessel's bows on to the sea, by putting ballast or some other heavy weight close forward, and running anchors away seawards, thus keeping the fore end of the vessel down, while the after end is allowed to remain light; the action of the sea might then drive the after end up towards the land, while the fore end, by being well ballasted, would remain stationary. If this did not succeed, a good purchase from the shore to the after part of the vessel might be used at the same time with success; then if the vessel was but slightly damaged I would caulk the ceiling (small wooden vessel) or put in bulkheads or other matter required, provided a place of safety were near at hand. where the vessel might be taken into and repaired. If not, I should be obliged to be more particular in the repairs, in order that the ship might be taken to a greater distance; or she might be raised upon ways by screws if the tide ebbed far enough out, and afterwards launched, and hove off to the anchors.

Q. Would you act in the same manner in foreign ports?

Ans. Yes; in those parts where instructions from the owner of the vessel would not reach me in time, so as not to cause delay or prove injurious to the property under my command.

Q. If you were at too great a distance to correspond with the owner, what would you do?

Ans. I would have a survey made by an experienced shipmaster and a merchant or shipbuilder, if such persons were to be obtained; if not, I would be guided by my own judgment with the assistance of the most experienced men I could find, and abide by the decision then made.

Q. If your vessel were driven among rocks, what means would you take to save the lives of all on board, and part or the whole of the cargo, if practicable.

Ans. If the rocks were near the shore or above water I would get the end of a good hawser made fast to the shore or to the highest rock within reach of the vessel, making the other end fast on board, and set it well tight with good purchase on which I could construct a traveller, with a chair or something of the same nature slung to it, and in this manner haul the passengers, crew, and property on shore.

Q. How would you get the end of the hawser made fast to the shore?

Ans. In all probability there would be people on the shore to make it fast. I would send it to them in the following manner:—By making a cork fender or some other buoyant substance fast to a small line (such as the log line or leadline), it would on being thrown overboard, drive on shore with the small line; a larger line might then be hauled to the shore and afterwards the hawser. If the place were uninhabited other means might be used; I would endeavour to get on shore by swimming, with the assistance of a lifebuoy or in a boat or in any other manner which circumstances might suggest or permit; and as it is not probable that the vessel could be got off a bed of rocks, I would get what I could from her.

Q. Suppose the land inhabited, but the shore high and precipitous, so that no communication can be held between the foot and top of the cliff, how would you endeavour to open a communication with the people on the top?

Ans. It could not be done by floating a line ashore, nor by a man swimming; the line must be sent up into the air, this can be accomplished by means of a kite. Take a light hoop, but if you have none handy, take three light pieces of wood and bind them strongly together in the shape of a triangle, and cover it with canvas; attach three or four pieces of strong cord at equal distances to the wood, and fasten the ends securely to a light line. The shore being a lee shore the kite will be driven by the gale shorewards. If it reaches the top safely proceed as before described.

There used to be a kite patented by Captain Nares, R.N., with everything ready for instant use, and could be obtained at any port.

Q. If the vessel struck on a bed of sunken rocks, what would you do?

Ans. I would take to the boats, having them stowed with provisions and water in the best manner circumstances would permit. If the boats were disabled, I would construct a raft.

HOW TO RAISE A SUNKEN VESSEL.

Q. How would you raise a small sunken vessel?

Ans. I would sling her with good cables, and raise her between two or more vessels or floats constructed for the purpose.

Q. How would you sling her?

Ans. Having ascertained the position in which the vessel was lying I would sweep each end of her with the bights of two cables of sufficient length to allow the ends to remain above water. I would then take two other short pieces of cable (about two-thirds of the length of the vessel) and shackle a large link at their ends, through which I would reeve the ends of the first mentioned cables and allow the short pieces to sink to the bottom one on each side of the vessel, they would then act as bridles and keep the end cables from slipping; all being thus united would securely sling the vessel and the greater the strain on them the tighter they would grip.

Q. Having slung the vessel how would you proceed to raise her?

Ans. The power of buoyancy must be regulated by the weight to be raised. The general principle, however, under which I would act, would be to place two vessels one on each side of the sunken vessel as near to her as possible. I would then place two logs of timber directly over the sunken vessel, with their ends resting on the decks of the vessels used to raise her, and having their decks and beams well fortified to bear the pressure. The ends of the slings must then be made fast to the logs of timber and hove tight up at low water. As the tide returned all would rise with it (that is, if the power of buoyancy were sufficient for the purpose), then at high water all should be hauled into shoaler water till the sunken vessel again takes the ground; and so on every tide till the sunken vessel could be seen. The logs of timber must then be dispensed with, and the slings made fast to the vessel without them. Where there is no tide or there is little rise or fall the vessels which are used to raise the sunken vessel must be loaded before being hove down and afterwards discharged; as they rise out of the water they will lift the sunken vessel in the same manner as when lifted with the tide. They might be filled with water and pumped out if consistent with prudence.

The above method is seldom used now, as the modern salvage boats have appliances for patching all holes, and powerful pumps sufficient to float most vessels.

MISCELLANEOUS QUESTIONS.

Q. If you had to slip from the Downs, wind from the SW, what would you do?

Ans. I should set my three topsails, foretopsail aback; foretopmast staysail weather sheet aft, have other sails loosed and ready for setting, and a spring from my starboard quarter. Buoy the cable and slip, and when the ship is sufficiently round, cut the spring and fill away. Bring the high light over the middle of Old Stairs Bay.

Q. In a steamer loading in an open roadstead, what would you do?

Ans. Have the fires banked and get everything ready for slipping, if necessary.

Q. Your ship is on shore, listed with her decks towards the sea, what would you do?

Ans. Try and get her listed with her decks towards the shore, by shifting cargo or heavy weights, or try and get her head on to the sea.

Q. What would you do if you were in collision with another ship?

Ans. Ascertain at once if the ship is likely to keep afloat, stand by the other ship and render any assistance that may be necessary, the other ship will have to do the same; ascertain her name and port of registry.

Q. What is spontaneous combustion?

Ans. The ignition of a body, without any external flame; it is generally caused through moisture.

Q. What cargoes are liable to spontaneous combustion?

Ans. Jute, flax, hemp, wheat, cotton, coal, grass, etc.

Q. You are in a light steamer short of coal in the middle of the North Sea, gale of wind right ahead, what would you do?

Ans. Unshackle the cables from the anchors and pay them out, ride to the cables until the weather moderates.

Q. Entering the Tyne or any other narrow entrance with a gale of wind right in, what would you do?

Ans. Go in with plenty of way on the ship. The best time to enter would be about high water.

Q. How would you test the stability of a new ship loading coal?

Ans. Team a waggon or two at one side and note what she goes over, then team the same quantity on the same side; if the stability be good the ship will not go over so far with the second lot of coal as she did with the first.

Q. What would you do in a broken down steamer, on her beam ends?

Ans. Get her head to sea with a sea anchor, and if possible trim her upright by shifting the cargo.

Q. How would you tell the quantity of coal a bunker will hold?

Ans. Multiply the length, breadth, and height, and divide by 45, will give you the quantity in tons for ordinary bunker coal.

Q. What would you do if the key of the propeller was loose?

Ans. Avoid coming astern and ride to a sea anchor if she is likely to race in bad weather.

Q. How would you get a tow line on board of another ship in a heavy sea?

Ans. Get to windward and drift a life-buoy or anything that will float a small line to him; or fire a rocket with a small line attached to it.

Q. How would you take the crew from a disabled ship?

Ans. Distribute oil to leeward of the disabled ship and then steam to windward and launch the boat with all the necessary gear in her, using plenty of oil. The boat will be able to run before the sea to the disabled ship, and the time she is taking the crew off I can steam to leeward and wait of the boat returning.

Q. How would you take a turn out of the cables?

Ans. Lash the two cables together as low down as necessary, unshackle the one I am not riding by, and pay it out of the hawse pipe, take the turns out; pass it up through the hawse pipe again and shackle on.

Q. You are coming North along the Yorkshire coast in a light steamer, NE gale of wind, the ship is gradually sagging down on to the land, she will not stay and there is not room to wear, what will you do to get her on the other tack?

Ans. Full speed astern, the wind and sea will pay her bow off towards the land; when there is sufficient room, go ahead with the helm hard a starboard, bringing the wind on the port bow.

Q. You are going with the flood tide, and see a can buoy on your starboard bow, what would you do?

Ans. Hard a port and bring it on my port bow.

Q. How would you make a report on a damaged ship if called upon to do so?

Ans. I would state all, even the smallest things and parts damaged; then the words "lost, damaged, or destroyed; and we further recommend that these repairs be carried out" or words to the like effect.

Q. How would you report on a damaged cargo?

Ans. State how it was stowed and dunnaged, the damage done with marks and numbers of the packages; and "we recommend that the damaged goods be sold and the rest re-shipped."

Q. You are in a light steamer on a lee shore; it is impossible for her to work off either on the port or starboard tack; is there anything you can do to save the ship?

Ans. Take the man hole door off the after tank and run the after hold up with water to about the tunnel top.

Q. You are lying moored bow and stern in a tier, tide ahead; what would you do if the bow moorings parted?

Ans. Let go the anchor, pay out cable and let her swing to the stern moorings.

Q. How much cable would you pay out when turning a steamship round the anchor?

Ans. About three times the depth of water or just sufficient for the anchor to hold.

Q. You are going into a bay, light steamer, strong wind aft, you find that you have to come out again and she won't turn round; what would you do?

Ans. Bring her full speed astern and let her come out stern first.

Q. Wind SW in North Atlantic; if the wind shifts, what direction will it likely blow from?

Ans. NW.

Q. What would you do if your funnel was carried away?

Ans. Rig a jury funnel with all the spars, planks, and boards I could get, and cover the outside with canvas.

Q. What would you do going into a roadstead blowing hard (light steamer)?

Ans. Pick out a good berth; steam towards it and drop the anchor; then let her swing whichever way the wind and tide will allow her.

Q. You are lying in a tier, ships on each side of you, tide aft; how would you get out?

Ans. Go out head first; the other ships will slack their head moorings, if necessary.

If the tide was ahead drop her out stern first.

Q. How would you warp a steamer up a dock?

Ans. Have two warps forward and two aft; when heaving on one of the forward warps, the other can be run out to the next buoy further ahead, and when slacking away on one of the after warps, the other can be run out to the next buoy. Always have one warp fast before the other is let go.

Q. Ship lying stopped in tide way, no wind; she is by the stern, how will she lay with the tide?

Ans. As the stern is the deepest end the tide will have more effect aft and consequently she will lay with her head towards the tide.

If she was by the head she would lay with her stern towards the tide.

Q. How would she lay if there was only wind and no tide?

Ans. She would lay stern towards the wind when by the stern and bow towards the wind when by the head.

Q. Your ship is ashore, wind on to the land, all boats are gone, no one on shore; how would you land?

Ans. Lash three spars together in the form of a triangle, lace between the spars with rope; launch the raft, a few hands get into it, the wind will blow it on shore. If the ship is not too far from the shore the raft can be hauled back to the ship, other hands get into it and these on shore can haul it back.

Q. Your ship goes on to a sand bank, get her off?

Ans. Sound round the ship and sound seawards, run a kedge in the direction where there is sufficient water, then run off a bower anchor hauling out to the kedge. Heave her off with the bower; part of the cargo may have to be jettisoned, or you may have to wait until the tide rises.

Q. Your tiller is carried away or the quadrant broken, what would you do?

Ans. Rig a jury tiller by lashing a good spar or iron bar to the remaining part.

Q. What would you do in the case of sickness?

Ans. Ascertain the symptoms and consult the medical guide so as to try and make sure of the nature of the sickness.

Q. Making a passage from one port to another, what would you be particular about in a steamer?

Ans. Make sure that I had a few days' extra coal, and if it is a time of the year when head winds are likely to ensue more allowance still will have to be made.

Q. You are in dock and get a wire round your propeller, what would you do?

Ans. Heave on it and try and get it clear; whilst heaving the engines may be reversed a turn or two. In all probability a diver will have to be employed, and if he cannot get it clear the ship will have to be docked or cargo will have to be discharged to allow the boss of the propeller to come to the surface.

Q. Railway iron adrift in the hold, what would you do?

Ans. Tom it off the best way I can. As the iron works towards one side drop the toms or chocks into the spaces where you can get them; do likewise when it works towards the other side until you have it secure. The booms will likely have to be sawn up for toms.

Q. You are in a sailing ship laden with railway iron, she is thrown on her beam ends and her cargo shifted, what will you do?

Ans. Cut away the masts and let them go over the lee side. When clear of all the wreckage get out a sea anchor and try to right the ship.

Q. How would you tell the rate a tidal wave was travelling along the coast?

Ans. Note the time of high water of two different headlands, and the difference between the times of high water will be the time the wave travels from one headland to the other.

Q. You strike a rock and damage your forefoot; water is coming in, what will you do?

Ans. Fill up with plenty of cement, board the cement over and shore it securely down.

Q. How would you discharge cattle, lying 16 feet from a quay?

Ans. Rig a good gangway for them to walk on shore.

Q. What is the cause of land and sea breezes?

Ans. During the day the atmosphere is warmer over the land than over the sea, consequently the air over the land expands and becomes lighter; causing a breeze from the sea where the pressure is greatest.

During the night the atmosphere is colder over the land than over the sea, consequently the air over the land contracts and becomes heavier, causing a breeze from the land where the pressure is greatest.

Q. What causes monsoons?

Ans. The pressure caused by temperature is greater over the land than over the sea for one period of the year and greater over the sea than over the land during the remaining period. In the Bay of Bengal, Arabian and China Seas, the N.E. Monsoon blows during the period from October to April, and the S.W. Monsoon from April to October.

Q. What is a cyclone?

Ans. A region of low pressure surrounded by a region of high pressure.

Q. What is an Anticyclone?

Ans. A region of high pressure surrounded by a region of lower pressure.

Fine weather is usually experienced with anticyclones, the wind flows outwards from the centre in a spiral form and in a contrary way to a cyclone.

Q. A rivet is out of the shell under the ship's bottom, how would you stop the leak?

Ans. Pass an iron hook through the rivet hole from the inside of the ship; drag a thin line under the bottom on the outside of the ship until it is caught by the hook; make the end of the line fast to a bolt and pull the bight of the line through the hole with the hook; haul away on the line and pull the bolt through the hole, then screw up tight.

Q. How would you calculate the distance from a gun?

Ans. Note the time when the smoke is seen, and note the time when the report is heard.

The interval is the time taken for the sound to travel to the observer.

Sound travels at the rate of 1090 feet per second, at a temperature of 32° Fahrenheit, and the speed is increased 1·15 feet per second for each degree above freezing point.

ICE LIMITS.

North Atlantic.

Lat. 39° N. between Longs. 40° and 50° W. the Strait of Belle Isle cannot be navigated until the end of June.

South Atlantic.

Ice as a rule is never seen to the Northward of 37° S, it has been seen (but very seldom) as far as 36° S.

About one-eighth of an iceberg generally appears above water.

FOGS.

British Islands.

January and June are the foggiest months, except in London where November is.

Banks of Newfoundland.

June and July, worst months.

Bay of Fundy.

Most prevalent in July and August.

Fogs are also prevalent at Cape Verde Islands in the summer; West Coast of Africa in the winter; North of the Equator and South of the Equator in June, July, and August; Rio de la Plata July to September; Peru, April to about August; Vancouver June to November; California during the summer; China, winter, and Japan summer.

LOWER MAST SPRUNG AT SEA.

Fish it with the best spars I have got, using the small spars to fill up cantlines; lash it with rope and chain lashings alternately, and wedge it.

Look to it every day, more particularly after severe weather.

EXPLOSIVES.

Q. What general precautions must be taken in shipping explosives?

Ans. The Board of Trade "stipulate for a substantial compartment formed of double boards, with an intermediate lining of felt," or they must be otherwise carefully stowed so as not to come in contact with or be in danger from any other part of the cargo; hence, they must be isolated by boards or surrounded by sailcloth or felt, to prevent the powder getting adrift during the voyage.

ECONOMY IN COAL CONSUMPTION.

Example 1.—A steamship steaming 12 knots per hour, consumes 27 tons of coal daily; what would be the daily consumption for a speed of 8 knots per hour?

Note.—The consumption varies as the cube of the speed.

$$\text{As } 12^3 : 8^3 :: 27 : x$$

$$\begin{array}{rr}
12 & 8 \\
\hline
144 & 64 \\
12 & 8 \\
\hline
1728 & 512 \\
\hline
 & 27 \\
\hline
 & 3584 \\
 & 1024 \\
\hline
\end{array}$$

$$1728)13824(8 \text{ tons.}$$
$$\underline{13824}$$

Example 2.—A steamship's consumption for each day, steaming 8 knots per hour, was 8 tons. What would be the speed per hour for a daily consumption of 27 tons?

Note.—The quickest and best method to get the cube root of 1728 is to take the log from T. xxiv and divide by 3. The number corresponding to the latter log will be the answer.

As 8 : 27 :: 8^3 : x^3

$$\begin{array}{rrl}
 & 8 & \\
 & 8 & \\
\hline
 & 64 & \\
 & 8 & \\
\hline
8^3 = & 512 & \\
 & 27 & \\
\hline
 & 3584 & \\
 & 1024 & \\
\hline
 & 8)13824 & \\
\hline
x^3 = & 1728 & \text{Log} \quad 3)3{\cdot}237544 \\
\hline
 & 12 & \text{Log} \quad 1{\cdot}079181
\end{array}$$

Answer—12 knots.

Example 3.—A steamship steaming at the rate of 12 knots consumes 33 tons of coal per day, and is going on a voyage of 2970 miles; what coal will she save if the speed is reduced to 9 miles per hour?

As 12^3 : 9^3 :: 33 : x

$$\frac{9^3 \times 33}{12^3} = 13{\cdot}92 \text{ tons}$$

```
                 24
          Rate   12
                ———
Daily run 288)2970(10·31 days
              288
              ———
                900
                864
                ———
                 360
                 288
                 ———

             10·31 days
                33 tons
             ——————
              3093
             3093
             ——————
            340·23 tons
            ——————

                 24
          Rate    9
                ———
Daily run 216)2970(13·75 days
              216
              ———
               810
               648
               ———
               1620
               1512
               ————
                1080
                1080
                ————
```

```
    13·75 days
    13·92 tons
    ------
     2750
   12375
   4125
  1375
  --------
  191·4000 tons
  --------
```

Tons for speed of 12 knots	340·23
Tons for speed of 9 knots	191·40
Coal saved	148·83

STOWING CASES.

A compartment 38 feet in length, $27\frac{1}{2}$ feet in breadth, and 7 feet high. How many cases 7 feet 6 inches long, 27 inches broad, and 9 inches deep will you get into this compartment?

Length	38 ft.	Breadth	27 ft. 6 in.	Depth	7 ft.
Length	7 ft. 6 in.	Breadth	2 ft. 3 in.	Depth	$\frac{3}{4}$ ft.
	5		12		9
5 Cases	37 6	12 Cases	27 0	9 Cases	$6\frac{3}{4}$

It will be possible to get 5 cases lengthwise, 12 cases breadthwise, and 9 cases high, with a few inches to spare each way.

$$5 \times 12 \times 9 = 540 \text{ Cases.}$$

SHIP'S BUSINESS.

Invoice, Charter Party, and Bill of Lading.

Q. You are appointed Master of a ship, what is the first thing you would do on taking command?

Ans. Get all the ship's papers from the last Master, and enter a list of them in the Official Log Book, and sign it myself, and get the late Master to sign it also; take the ship's Register to the Custom House and get my name put on it if in a British port, and to the British Consul if in a foreign port.

Q. What is a Charter Party?

Ans. A written contract entered into by a Merchant and a Shipowner (or the Master), for the hire of a ship for a specified time or voyage. The Owner contracts to supply a stout ship, properly supplied with the necessary stores and provisions, and properly officered and manned. The Merchant contracts to supply cargo and pay certain freight for the use of the ship.

Q. What would you be careful to see was in the Charter Party?

Ans. The freight, lay days for loading and discharging, and the rate of demurrage.

Q. What are lay days?

Ans. Days allowed for the ship to load or discharge. Sundays and Holidays do not count, unless the phrase "running days" is mentioned, when all days count.

Q. What are demurrage days?

Ans. Extra days for loading or discharging, when the Merchant has, from any cause, been obliged to detain the ship over the lay days. Sundays and Holidays to count.

Q. Your ship is ready to receive cargo, what would you do?

Ans. Have my ship moved to the place specified for receiving the cargo; then give a written notice to the Merchant that I was ready to receive cargo and should come on my lay days the next day, and enter a copy of this notice in the ship's log.

Q. When the goods come on board, what document comes with them?

Ans. An invoice; which is often called a boat n te.

Q. What is an invoice?

Ans. An account of the goods shipped, with their marks and numbers, the name of the vessel and the Master, the port of destination, the name of the consignee, and a description of the goods, with their cost and charges.

Q. How many invoices usually come off, and what becomes of them?

Ans. Two. The mate signs one and gives it back, and files the other.

Q. Your lay days have expired, but the cargo is not all on board, what would you do?

Ans. Give a written notice to the Merchant informing him of the fact, and advising him that I shall come upon demurrage the next day; then enter a copy of the notice in the ship's log.

Q. How is demurrage to be claimed?

Ans. Day by day, and on Saturday for Saturday and Sunday.

Q. In the Charter Party you promise that the goods shall be delivered at the port of discharge in the same good order in which they are received on board; what is the exceptional clause put in?

Ans. "The Act of God, the King's Enemies, Restraints of Princes and Rulers, Pirates, Fire, and all and every other Dangers and Accidents of the Seas, Rivers, and Navigation, of what nature and kind soever, during the said voyage, being always excepted."

Q. If it were a steamer, what additional clause would you have?

Ans. "Accidents from boilers or engines."

Q. What makes the Charter Party legal?

Ans. The stamp.

Q. Does a Charter Party entered into abroad, where no stamp is required, require one when it reaches England?

Ans. Yes; a sixpenny stamp must be put on within a week of it reaching the United Kingdom.

Q. What makes it binding?

Ans. The penalty clause.

Q. What is the penalty clause?

Ans. "The penalty for the non-fulfilment of the contract to be the estimated amount of freight"; sometimes a stipulated sum.

Q. Who cancels the stamp?

Ans. The person who signs last.

Q. Who signs last?
Ans. The last contracting party.

Q. How do you cancel the stamp?
Ans. By writing my name across it and dating it.

Q. What is the penalty for not cancelling a stamp?
Ans. Fifty pounds.

Q. When is the Charter Party considered to be complete?
Ans. When it is dated, signed, and the stamp cancelled.

Q. When the cargo is all on board, what document has the Master to sign?
Ans. The Bill of Lading.

Q. What is the Bill of Lading?
Ans. The master's receipt for the goods on board, and his promise to deliver them in the same good order in which he has received them.

Note.—As the Bill of Lading is the master's receipt, he should naturally make it out himself from the invoices filed by the mate; but it is the general custom for a clerk in the merchant's office to make it out, and the master goes to the office, checks, and signs it.

Q. What is meant by a set of Bills of Lading?
Ans. Three or more copies of the same all stamped, and signed by the master, with the exception of the one he keeps for himself.

Q. How are they distributed?
Ans. One is sent by post to the consignee, one is kept by the master (not stamped), and the rest by the merchant.

Q. There being so many Bills of Lading, is there not a risk of having two or more presented to you at your port of discharge?
Ans. No; there is always a clause in the Bill to this effect:

"In Witness whereof, the master or purser of the said ship hath signed Bills of Lading, all of this tenor and date, one of which being accomplished, others to be void."

Q. What is the "exceptional clause" in a Bill of Lading?

Ans. The same as in a Charter Party:—The Act of God, etc., etc.

Q. What is the general clause?

Ans. "Contents, weight, quality, and quantity unknown."

Q. What special clause would you have in it?

Ans. Freight, demurrage, and all other conditions, as per "Charter Party" dated———.

Q. What extra clause would you have for a steamer?

Ans. "With liberty to call for coal at any intermediate port or ports; to sail with or without pilots; and to tow and assist vessels in all situations of distress."

Q. What would you do before signing the Bill of Lading?

Ans. Read it carefully over and see that nothing in it was contrary to the Charter Party; see that all the goods mentioned in it are actually on board, by comparing it with the Cargo Book; get back the mate's receipts; see that the necessary clauses are in, and write any remarks opposite the different items that I thought the case required, to limit my responsibility.

Q. Suppose the Bill of Lading specified that you had 500 tons of iron on board, what would you write opposite to it?

Ans. Weight unknown.

Q. One hundred sets of polished fire-irons?

Ans. Not accountable for damage through rust.

Q. Grain?

Ans. Quality and quantity unknown.

Q. Cargo consisting of such things as bales of hemp, flax, etc.?

Ans. Weight and contents unknown.

Q. Barrels of beer, wine, or any liquids in casks?

Ans. Quality, quantity, and contents unknown; not accountable for *leakage*.

Q. Cases of wine?
Ans. Quality, quantity, and contents unknown; not accountable for *breakage* or *leakage*.

Q. Crates of earthenware or glass?
Ans. Contents unknown; not accountable for *breakage*.

Q. Six chests of silver?
Ans. Weight and contents unknown.

Q. Suppose you take goods at a reduced freight, but with the understanding that they are to be used as dunnage, what would you write opposite?
Ans. Shipped as dunnage.

Q. If live stock?
Ans. Not accountable for *accidents* or *mortality*.

Q. What extra precautions would you observe if the goods were to be delivered in an open bay?
Ans. I should, besides the above remarks, write—"To be taken from the ship's tackles at the risk and expense of the consignee," unless I was paid extra freight for taking the risk on myself.

Bill of Health.

Q. Before sailing for a foreign port, what document must you get?
Ans. A bill of health, and have it endorsed by the Consul of the country I am bound to.

Q. Where do you get this bill of health?
Ans. From the health officer of the port, if there is one; if not, at the Custom House.

Q. What is a bill of health?
Ans. A certificate stating the general good health at the port of departure.

Q. Suppose you had no bill of health?
Ans. The ship on arrival would be placed in quarantine, and much delay and trouble ensue.

Q. Where do you get the bill of health in a foreign port?
Ans. From the British Consul.

Manifest.

Q. What is a manifest?

Ans. It is a document dated and signed by the master, and should contain the name and registered tonnage of the ship, her port of registry, the master's name, a list of crew and passengers (if any), an account of all the packages on board, with the marks and numbers thereon, and the contents; the names of the place or places where the goods have been shipped, and their destinations; also the names of the respective shippers and consignees.

In many foreign ports a list and description of the stores, materials, provisions, and private effects, etc., on board the ship are also required.

After Sailing—Survey, Protest, Bottomry, Respondentia, Dead Freight, Bill of Exchange, etc.

Q. You have left port, what would you do before the pilot left you or before the tug cast you off?

Ans. Muster the crew aft, and send a list of the absentees (if any) to my owners and to the Shipping Office (E.N.G.).

Q. You have bound yourself to make the best of your way to your port of discharge, may you deviate from your course?

Ans. Yes; to avoid an enemy: severe weather; to obtain necessary repairs or provisions; or in case of sickness breaking out amongst the crew.

Q. Suppose you enter a foreign port to land a man sick or disabled, describe how you would proceed.

Ans. I should enter with a quarantine flag flying. The proper officer would board me, and after examining the sick man and the whole of the crew on board, and finding nothing infectious would permit me to land. I should go to my Consul and get permission to send the man to the hospital, then land him. I should have to take the ship's articles on shore to the Consul and leave a proper discharge for the man, and whatever sum of money the Consul should demand for the man's keep and expenses; the balance, if any, will be returned to my owners; and if I wish to ship a man to fill the vacancy, I must ship him before the Consul; afterwards sail with the first opportunity.

Q. Suppose you have put in with your decks swept and bulwarks gone, etc., what would you do?
Ans. Report myself to the port authorities and to my Consul and note a protest.

Q. What next?
Ans. Call a survey on my ship.

Q. Whom would you call on this Survey?
Ans. Two shipmasters or other experienced persons.

Q. Are you bound to call Lloyd's agent?
Ans. No.

Q. May you call him in?
Ans. I may; not as Lloyd's agent, but as a private person well qualified for the work.

Q. What should surveyors put in their report?
Ans. "Lost, damaged, or destroyed."

Q. Suppose the Surveyors order you to discharge, and your repairs will take some time, what would you do with the cargo?
Ans. Hire another ship to take it on.

Q. You cannot get another ship?
Ans. If a perishable cargo, sell it; if not, warehouse it. I should telegraph or write home to my owners, informing them what I had done.

Q. In all cases, what should you do before breaking bulk?
Ans. Call a survey on my hatches.

Q. Whom would you call?
Ans. Two shipmasters.

Q. Upon discharging cargo you find some damaged, what would you do?
Ans. Call a survey on it.

Q. Whom would you call?
Ans. Two Merchants who are acquainted with the kind of cargo.

Q. What would they report upon?

Ans. Whether the cargo was properly stowed and dunnaged and the amount of damage.

Q. What would you do after receiving their report?
Ans. Extend the protest.

Q. In extending a protest, what must you be very careful about?
Ans. To see that nothing is put in it that cannot be proved by the ship's log.

Q. If you were in a steamer and had gone in with machinery damaged, whom would you call on the survey?
Ans. A shipmaster and an engineer.

Q. Suppose you had no money to pay for the repairs, how would you set about getting it?
Ans. Telegraph or write to my owners, if I could do so.

Q. Suppose you are too far off to do so in a reasonable time, what would you try next?
Ans. To raise the money by a bill upon my owners.

Q. You cannot succeed in so raising it; what next?
Ans. Try to get it on a bottomry bond.

Q. What is a bottomry bond?
Ans. Raising money for the necessary repairs of the ship upon the ship as security.

Q. What is the difference between a bottomry bond and a mortgage?
Ans. A bottomry bond is entered into by the master. The money so raised must be spent upon the necessary repairs of the ship only, and be repaid with interest on the completion of the voyage.

A mortgage is entered into by the owner. The money raised may be spent as he likes, and the interest and principal paid at the times stated in the deed.

Q. How would you proceed to get a bottomry bond?
Ans. I would advertise and accept that offer which was for the lowest interest.

Q. How many bottomry bonds may a ship have on one voyage?
Ans. As many as may be necessary to carry her to her final port of discharge.

Q. Show what you mean.

Ans. Ship gets a bottomry bond at port A, and then sails. She again meets with bad weather, is damaged, and calls at port B, where she gets a second bond, and after repairs, sails again. She again meets bad weather, is damaged, goes into port C, gets a third bond, repairs, sails, and reaches her final port of discharge.

Q. How are these bonds paid?

Ans. The last first, and so backwards. C, B, and last A.

Q. Supposing the ship had been lost before leaving port C?

Ans. Then the principal and interest of all the bonds would have been lost.

Q. Supposing you could not raise money by a bottomry bond, what could you do?

Ans. Try to raise it on the cargo (respondentia). If I could not get it by that means then I would be obliged to sell sufficient of the cargo to raise the necessary money.

Q. Is there anything payable before a bottomry bond?

Ans. Yes; seamen's wages.

Q. What is meant by Respondentia?

Ans. The pledging of the cargo to pay for the necessary repairs of the ship when the money cannot be obtained by any other means.

Q. Your repairs are completed, what would you do?

Ans. Call a survey upon the repairs so as to have a report that they are properly executed and that the ship is in a seaworthy condition.

Q. Why is this necessary?

Ans. To satisfy the Insurance Company and the Board of Trade.

Q. And then?

Ans. Make the best of my way to the port of discharge.

Q. Is there any precaution that you, as a careful shipmaster, could take for your owner's interest before sailing?

Ans. Yes: I would make out a list of all my disbursements upon ship and crew while at the port, and send it to my owners by post, with copies of the necessary vouchers.

Q. On arrival at your port of discharge, what would you do?

Ans. Report myself to the port authorities and to my Consul and note a protest; and then look up my consignee.

Q. To whom would you deliver the cargo?

Ans. To the legal owner of the bill of lading.

Q. How would you know that the consignee legally held the bill of lading?

Ans. By the endorsement.

Q. Whose name would be on the back?

Ans. The original shipper's name.

Q. What difference is there between the bill of lading as it left your hand on signing it, and when you see it again in the consignee's hand?

Ans. It will now bear the endorsement of the original shipper.

Q. Supposing you could not find the consignee, what would you do?

Ans. Advertise for him.

Q. How long would you advertise?

Ans. During my lay days.

Q. What would you do with the cargo?

Ans. Discharge it into a warehouse. If the consignee turned up he could get it upon paying the charges; if he were still not to be found at the end of the lay days, then if it were a perishable cargo, I would sell it; but if it were not, I should get some responsible person to advance the freight and charges, he holding the cargo as a security till the consignee appeared, or instructions could arrive from the original shipper.

Q. In the last case, would you not be obliged to lay the demurrage days?

Ans. No.

Q. In all cases of dispute, detention, or difficulty, what should you do?

Ans. Write home to my owners a full account of the case, with copies of any documents.

Q. What precautions would you take with reference to bills, vouchers, protests, etc., before leaving port?

Ans. I would enclose verified copies in a letter to my owners.

Q. Suppose a merchant had stipulated to supply a full cargo, but finds he cannot, what would you do?

Ans. Have the unfilled space measured, calculate the freight I should earn upon that space, and claim the amount from the merchant as "dead freight."

Q. Suppose he refuses to pay, have you any lien upon the cargo already in for this "dead freight"?

Ans. No.

Q. How can you recover the money then?

Ans. Only by going to law to enforce the penalty clause in the Charter Party.

Q. Describe how you would act if thus left, with only a part of the promised cargo.

Ans. As before stated, I should measure the unfilled space and calculate what freight I should earn on it; then I should try to find another freight for the space; and if the rate of freight is against me I should claim the difference from the first party; taking care to refuse anything that would damage the cargo already in.

Q. When you go to sign the bills of lading and you find more put down than is on board, what would you do?

Ans. I would object, and if he persisted in keeping the wrong amount I would sign "so much" or "so many" in dispute.

Q. If he won't let you, and will have a clean bill signed?

Ans. I should get three blank bills, fill them in myself for the amount on board, sign them, give the merchant two of them, and proceed on my voyage.

Q. If your ship is chartered for a lump sum, what would you be very careful about?

Ans. To see that she was not too deeply laden.

Q. How would you do that?

Ans. By having the draft she is to be loaded to stated in the Charter Party, which should not be above my load-line mark.

Q. You are offered a charter in a foreign port for a place you were never at; what would you do before accepting it?

Ans. Ascertain full particulars about the place; if my ship can always lie afloat; whether to be afloat I must lie a long way from the shore; the prevailing winds and storms; whether ships there have often to slip; port charges; and its capabilities for food, fresh water, etc.

Q. You are kept on demurrage abroad; what would you do when you got your bill of lading back?

Ans. Write on it the number of days I have been on demurrage.

Q. What is a common bill?

Ans. It is a written agreement on stamped paper, in which the debtor agrees to pay his creditor, on a day specified, the sum of money which he owes him.

Q. Here is a form of one; explain it.

£250. *Sunderland, November 6th, 19—*

Sixty days after date pay to me or my order the sum of two hundred and fifty pounds, value received.

SAMUEL HORN.

To Mr William Cross, Merchant,
Sunderland.

Ans. This bill was drawn on Mr Horn by Mr Cross, who owned him the money, and Mr Cross accepted it by writing his name and the word "accepted" across it, also stating where it would be paid.

Q. Could Mr Horn make use of it before the 60 days expired?

Ans. Yes; he could pay it away by endorsing it; and the second holder could pay it away again by endorsing it under Mr Horn's endorsement.

Q. If, when abroad, you were offered a bill as above, and endorsed, what would you do before taking it?

Ans. Note the names and find out whether they were good names or not.

Q. What is a bill of exchange?

Ans. It is almost similar to a home bill; but on account of the risk incurred in sending it home, it is drawn in sets of three, and usually made payable so many days after sight.

The following is the form of one:

Exchange of £100. *Bank of California,*
No. 106. *San Francisco, Sept. 9th, 19—*

Sixty days after sight of this FIRST of EXCHANGE *(second and third of same tenor and date unpaid), pay to the order of John Thompson & Co., the sum of one hundred pounds sterling, value received.*

GEORGE WINTER,
To N. M. Rothschild & Sons, *Manager.*
St Swithin's Lane, London.

Q. If you took a bill of exchange for your freight, how would you transmit it to your owners?

Ans. Send No. 1 by post to my owners, and No. 2 by another mail, and retain No. 3 till I heard if the others had arrived or not.

Q. Suppose the crew complain of the provisions, when in port, what should be done?

Ans. A survey should be called on the provisions, and the award entered in the Official Log Book.

Q. If the crew refuse to go to sea through the alleged unseaworthiness of the ship, what should be done?

Ans. A survey must be called.

Q. Who pays?

Ans. The ship, if she is found to be unseaworthy; but the man or men who complained, if she is not. The money can be deducted from the wages when paid off.

Q. If scurvy should make its appearance amongst the crew when at sea, what would you do?

Ans. Increase the allowance of lime juice to one ounce (two tablespoonfuls) per day; give them preserved potatoes or onions, and greens, carrots, turnips, etc., if I had them; a plentiful supply of good water; attention to personal cleanliness, and to cleanliness, dryness and ventilation of the quarters of the crew, and give them gentle exercise. If in port, get fresh vegetables, watercresses especially, or fruit.

Average.

Q. What are the two kinds of average?
Ans. Particular average and general average.

Q. What is meant by particular average?
Ans. Where the loss falls on the ship, the cargo, or the freight, and which cannot be held as a loss for the benefit of all concerned. (Any damage or loss insured against.)

Q. And by general average?
Ans. Where the loss falls on the value of the ship, freight, and cargo (all parties concerned).

Q. Can you describe what is necessary to bring the loss under general average?
Ans. It must be a *voluntary sacrifice*, that is, the master, after consulting with the mates and crew, deliberately orders the cargo to be thrown overboard, the masts to be cut away, or anything else necessary to save the ship, secondly, there must be an *absolute necessity* for this loss; that is, the ship must be so situated that without this sacrifice the ship and cargo would be lost.

Q. A ship at anchor sees that she must be run into by another vessel if she does not slip; she therefore slips. Would the loss of chain and anchor come under general average?
Ans. Yes: because it was a voluntary sacrifice necessary to save the whole ship and cargo, and it did save them.

Q. A vessel at anchor is fouled by another vessel, and loss sustained, would this come under general average?
Ans. No: it would be particular average.

Q. A ship at sea is caught in a squall, whereby her masts are lost, is this a case of general average?

Ans. No: it would be particular average.

Q. If she had been thrown on her beam ends, and the masts had been cut away by the master's orders?

Ans. Yes: that would bring it under general average.

Q. Suppose you have incurred losses during the voyage which are proper subjects for a general average, what would you do on your arrival at your port or destination?

Ans. Make a regular protest, inserting the whole particulars of the jettison entered in the log book as soon after it as possible; and, along with two or more of the crew, I would make oath that the goods were thrown overboard, or the loss incurred for the safety of the ship and the rest of the cargo, and for the preservation of the lives on board, and for no other cause.

Q. Have you any lien on the cargo for the shipper's share of the loss?

Ans. Yes.

Q. What is a Maritime Lien?

Ans. A lien on the ship for the wages of the master and crew.

Q. What is a Constructive Total Loss?

Ans. When a vessel is so badly damaged and not worth repairing, as the cost of repairs will exceed the value of the ship.

The Underwriters take possession of the ship and pay the owners the full value for total loss.

Q. If you had been so placed during the voyage that you were forced to do something that will have to be settled by a general average, what would you get from the consignee before you delivered the cargo to him?

Ans. An average bond; a document by which he binds himself to pay his share of the general average.

Q. The owner is bankrupt, who is responsible for disbursements transacted abroad?

Ans. The master of the ship, who in all probability will be sued for the amount.

Q. What could the master do under such circumstances?

Ans. He could put a writ on the ship and keep it there until some interested party paid his claim.

Q. What is the weight of a quarter of wheat?

Ans. About 500 lbs., it varies.

Note.—The following questions will usually be asked by the Examiner.

MASTERS' BUSINESS.

Charter Party—An agreement between the owner and merchant for the hire of a ship for one or more voyages.

Bill of Lading—Master's receipt for the goods shipped on board.

Contents of Bill of Lading—A full account of cargo on board, by whom shipped, who consigned to, and clauses same as Charter Party.

Manifest—A document dated and signed by the master, containing full particulars relating to the ship, cargo, crew, and passengers (if any).

Putting into port with damage through stress of weather—Report myself to the port authorities, note a protest, call a survey and get a report from the surveyors, containing the nature and extent of the damage. Then extend the protest and call the surveyors again to survey the ship when all the damage is repaired, and get a certificate from them stating that the ship is fit to proceed to sea, and the repairs have been executed.

Bottomry Bond—A contract whereby a ship is pledged in security of money advanced for the purposes of her voyage.

Respondentia—A contract whereby the cargo is pledged in security of money advanced for the purposes of her voyage.

General Average—A voluntary sacrifice, whereby a part is sacrificed to save the remainder.

Particular Average—Accident unavoidably happening through some peril insured against.

Bill of Exchange—A request from one party to another, directing the latter to pay to some third party a certain sum of money at a certain date.

Grain Certificate—A certificate filled in by the master containing a full account of all the grain in the ship, how stowed, where stowed, precautions taken for the prevention of its shifting, and the ship's draught of water and freeboard.

Portage Bill—A bill showing the wages due to each member of the crew.

Demurrage—A stated sum to be paid at the expiration of the lay-days for every day detained.

Average Bond—A document signed by the consignee, agreeing to pay his share of any General Average that may justly arise.

Salvage Agreement—An agreement between the master and a contractor for the salving of a vessel and cargo.

Barratry—Any fraudulent act committed by the master or any of the crew.

What Documents to take to the Shipping Office—Ship's Register, Load Line Certificate, Officers' and Engineers' Certificates, Apprentices Indentures (if any).

Documents from the Shipping Office—Articles, E.N.G. or Return List, Accounts of Wages Book, Official Log, A.A., and Crew List for Owners.

Clearing out Customs, what to take—Ship's Register, last Light Bill, A.A., B.B., Content, Manifest, Victualling Bill, Cocket Card, and Jerking Note.

What Documents to get from Customs after clearing out—Port Clearance, Dock Pass, Light Bill, Bill of Health. The Bill of Health must be taken to the Consul of the country bound to, to be endorsed.

Entering in, what to take to the Custom House—Ship's Register, last Light Bill, Report List, Manifest, Bill of Lading, Searching Note, Quarantine Certificate, and Ship's Letter Declaration. (Two report lists are required for loaded ships and one for light.)

SHIPPING OFFICE & CUSTOMS DOCUMENTS.

Ship's Register—A document showing the ownership of a vessel and giving a general description of her. The Master's name is always on the back of the register.

E.N.G. or Return List—The list of crew sent back to the Shipping Office stating the names of any that have failed to join and substitutes engaged ("pier head jumps").

Articles—Agreement between the Master and Crew.

A.A.—Proof that the necessary certificated officers have been "signed on," and the crew engaged.

B.B.—Proof of the last crew receiving their wages and that the Official Log, Agreement, and Crew List have been delivered to the Shipping Master.

C.C.—A certificate for the coasting trade, certifying that the Master has deposited at the Shipping Office his Agreement, Official Log, List of Crew, and produced his own and Mate's certificates at the end of the half year.

Last Light Bill—To show when the Light Dues were last paid.

Cocket Card—A clearance card signed by the Searcher and Collector of Customs.

Content—A description of goods shipped, stores, number of crew and passengers (if any).

Manifest—A full description of all goods shipped with their marks and numbers.

Victualling Bill—A list of bonded stores intended for the voyage.

Jerking Note—A note to signify the vessel has been searched for unentered goods after discharging. It contains a list of bonded stores left on board.

Report List—A description of goods, stores, number of crew and passengers (if any).

Searching Note—A note certifying the ship has been searched on arrival.

Quarantine Certificate—A certificate admitting the ship to pratique, or permission for the master and crew to land.

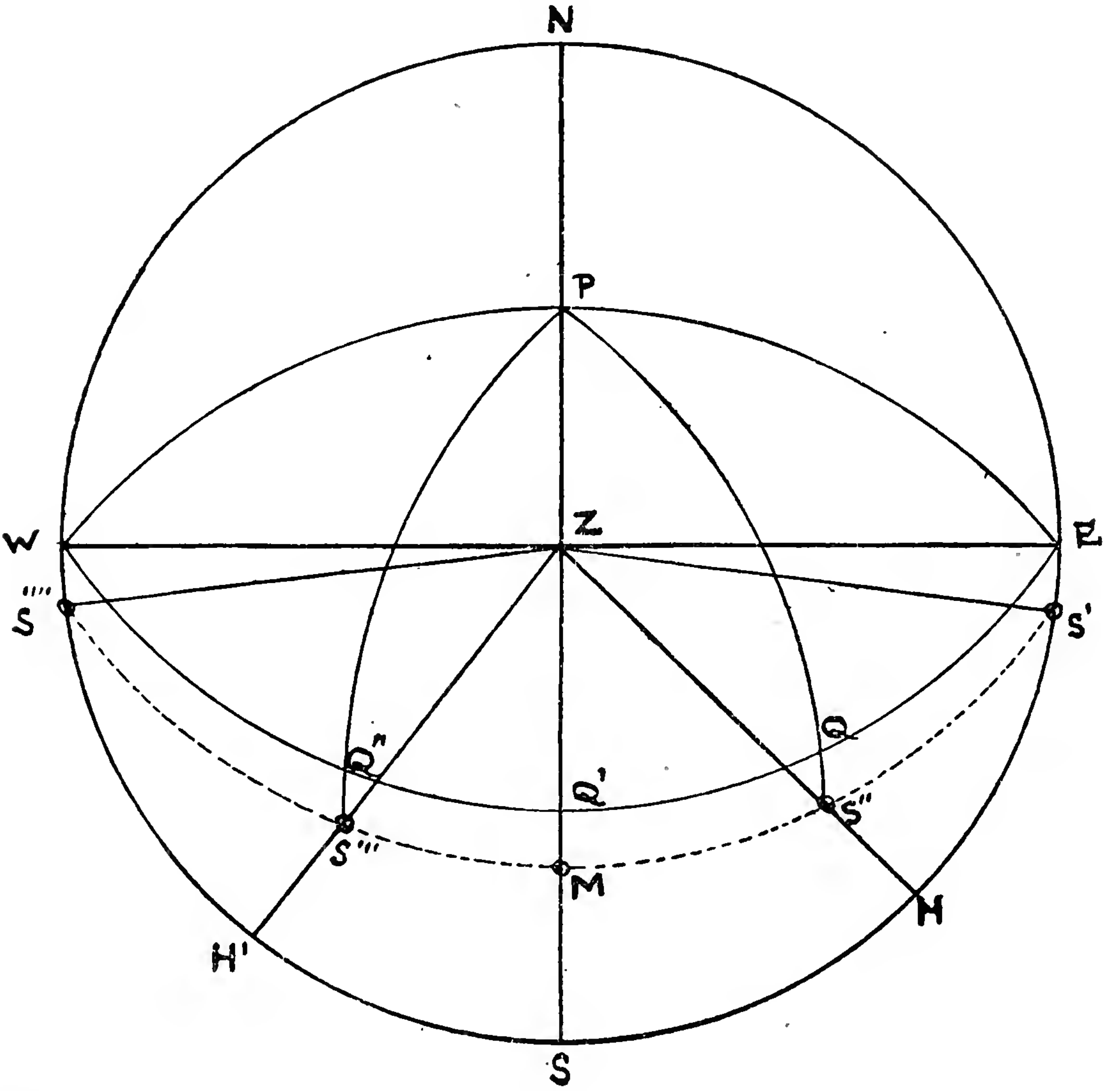
Ship's Letter Declaration—A document signed by the Master certifying that he has brought no letters.

PART II.

Diagram.

It is essential that this diagram should be thoroughly understood as the parts are used in the nautical problems.

Fig. 92.



N E S W represents the rational horizon.

P the pole. N and S. North & South points of the horizon.

Z ,, zenith. E & W. East & West points of the horizon.

P N = the altitude of the pole which is equal to Z Q' the latitude of the place.

S′, S″, S‴, S⁗ is the parallel of the object's declination and represents the object in four different positions from rising to setting.

Z S′, Z S″, Z S‴, and Z S⁗ = Zenith Distance.

S″ H and S‴ H = True Altitude.

P S″ and P S‴ = Polar Distance.

Q S″ and Q″ S‴ = Declination.

Z P S″ = nearly three hours of easterly hour angle.

Z P S‴ = about two and half hours of westerly hour angle.

P Z S″ or S Z S″ = True Azimuth.

P Z S‴ or S Z S‴ = True Azimuth.

E Z S′ or E S′ = True amplitude at rising.

W Z S⁗ or W S⁗ = True amplitude at setting.

N Z S = Observer's Meridian.

W Z E = Prime Vertical.

W P E = Six hours circle.

P Z = Co-latitude.

M is the object on the meridian.

M S = Meridian Altitude.

Z M = Meridian Zenith Distance.

Q′ M = Declination.

P M = Polar Distance.

The latitude of this diagram represents about 48° N; the circles drawn to the pole or passing through it are meridians; the circles (which are drawn as straight lines) meeting the zenith or passing through it are vertical circles.

N Z S is both a meridian and a vertical circle.

QUESTIONS 4, 5, and 6 on CHART.

To be answered in writing.

4. What do you understand the small numbers to indicate that you see placed about the chart, and at what time of tide?

The depth of water in feet or fathoms at mean low water spring tides unless otherwise stated.

5. What do the Roman numerals indicate that are occasionally seen on the charts near the coast and in the harbours?

The time of high water at full and change of the moon at that place.

6. How would you find, approximately, the time of high water at any place, the Admiralty tables not being at hand, nor any other special tables available?

To the time of the moon's meridian passage corrected for longitude, add the port establishment; the result is the time of high water P.M. if it less than 12 hours.

If more than 12 hours, subtract 12h. 24m. for the P.M. tide, and if more than 24 hours, subtract 24h. 48m. for the P.M. tide.

Explanations—The moon's mer. pass. is got from the naut. alm. Two minutes is allowed for every hour of longitude.

The port est. is the time of high water at full or new moon, which can be got from any tide table or from the chart.

When the hours are over 12 it is high water A.M. next morning, and when over 24 it is high water P.M. next day.

MEANING OF WORDS USED IN THE DEFINITIONS.

Which may be asked by the Examiner.

Great Circles—Circles whose planes pass through the centre of any sphere.

Small Circles or Lesser Circles—Circles whose planes do not pass through the centre of any sphere.

Sphere—Globe or ball.

Axis—Is the diameter around which the earth revolves.

Apparent—As it appears from the position of the observer.

Parallel—Two lines which never meet, no matter how far extended.

Vertical—Perpendicular to the sensible horizon (straight up and down).

Horizontal—Perpendicular to vertical (level).

Perpendicular—At right angles.

Right Angle—An angle measuring 90°.

Plumb Line—Hangs vertically.

Angle—Inclination of two lines meeting at a point.

What forms the measurement of an angle?—The arc which subtends the angle.

Subtended—Opposite.

True Meridian—Meridian passing through the true poles.

Magnetic Meridian—Meridian passing through the magnetic poles.

Altitude—Height.

First point of Aries—Where the sun cuts the eqinoctial passing from South to North.

Equinoctial—Celestial Equator.

Arc—Part of a circle.

Angular measurement or angular distance—The arc which measures the angle.

Zenith—Point in space overhead.

Nadir—Point in space beneath the observer's feet.

Radius—Half the diameter.

Plane—Flat surface.

Elevated Pole—Pole nearest the observer.

What measures an angle at the Pole—An arc of the equator.

What measures an angle at the zenith—An arc of the horizon.

Centre of a circle—A point equi-distant from any part of the circumference (middle).

Circle—A line, any part of which is equi-distant from a point, that point being its centre.

For Barometer, Thermometer and Hydrometer see "Reed's New Guide Book" or "Reed's Memory Work."

THE SEXTANT.

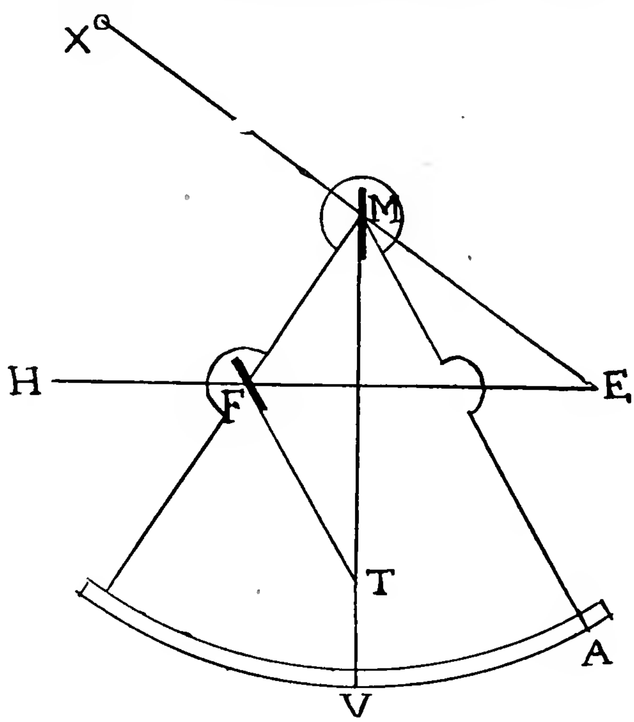
The sextant is an instrument for measuring angles, either vertical, horizontal, or oblique.

The form and principal parts are illustrated on page 277, (Fig. 94).

The principle of the Sextant.—A ray of light coming from an object X, falls on the index glass M, and is then reflected to the horizon glass F, whence it is again reflected along the line of sight F E to the eye E—that is, three rays XM, MF, and FE, and two reflections at M and F.

The angle between the first ray XM and the last ray FE = XEH, which is the angle measured.

Fig. 93.



This angle XEH is *double* the angle between the glasses M and F—that is, double the angle FTM, consequently a sextant only measures half the angle, but in order to avoid the necessity of doubling the reading, 60° on the arc (sixth of a circle) is graduated to 120° and 45° on an octant (eighth of a circle) is graduated to 90°.

An octant is usually called a quadrant. A is the zero on the arc, V is the zero on the vernier; H is the Horizon.

AV = AMT and AMT = FTM, ∴ AV = FTM, the angle between the index and horizon glasses.

Errors of the Sextant. All parts of the sextant should be well joined together. The index glass, horizon glass, and all shades should be perfectly flat and smooth; the sides of these glasses should be parallel to each other.

The arc should be perfectly graduated, and the index glass should be perfectly centred—the axis should be exactly at the centre of the arc.

These are all errors in the construction of the instrument. At Kew observatory certificates are given stating the power of the telescopes, shade errors and the errors in the readings for every 15° (A, certificate) and for every 30° (B, certificate).

The index and horizon glasses have each to be perpendicular to the plane of the instrument; they have also to be parallel to each other when the index is at zero. These three adjustments can be made by the observer; the observer can also set the line of sight parallel to the plane of the instrument.

Principle of the vernier. The vernier is to enable the observer to read to aliquot parts.

The number of divisions on the vernier are made one more than a corresponding number of divisions of the arc:—20 equal parts on the vernier equal 19 on the arc, 40 equal parts on the vernier equal 39 on the arc, and 60 on the vernier equal 59 on the arc.

Index and Horizon Glasses. The index glass is a mirror, every part of it is silvered.

The horizon glass is half silvered and half transparent; the true object or true horizon is seen through the transparent part, and the reflected object or the reflected horizon is seen in the silvered part.

ADJUSTMENTS OF THE SEXTANT.

(FOR ALL CANDIDATES.)

Vivâ Voce.

Q. What is the first adjustment of the Sextant?

Ans. To set the index glass perpendicular to the plane of the instrument.

Q. How do you make that adjustment?

Ans. Place the vernier near the middle of the arc, and look into the index glass to see the arc and its reflection appear in one continuous line; if they do not, slacken or tighten the upper screw in the frame upon which the glass stands until they do.

Q. What is the second adjustment?
Ans. To set the horizon glass perpendicular to the plane of the instrument.

Q. Describe how you make that adjustment.
Ans. Clamp the index at 0, hold the instrument obliquely* (nearly horizontal) and look through the telescope at the horizon to see the true and reflected horizons appear in one line; if they do not, move the upper screw at the back of the glass until they do.

Q. What is the third adjustment?
Ans. To set the horizon glass parallel to the index glass when the index is at 0.

Q. How would you make the third adjustment?
Ans. Clamp the index at 0, hold the instrument vertically, and look through the telescope at the horizon to see the true and reflected parts form one line; if they do not, move the lower screw at the back of the glass until they do.

SECOND AND THIRD ADJUSTMENTS.

By a Celestial Object.

Clamp the index at 0, hold the sextant vertically, look through the telescope direct at the object (sun, moon, planet or star): if both adjustments are correct, only one object will be seen as the true and reflected will coincide.

If the true and reflected are visible with one vertically above or below the other, the third adjustment is incorrect; move the lower screw at the back of the horizon glass until both objects are on the same level.

If the true and reflected are visible with one to the right or left of the other, the second adjustment is incorrect; move the upper screw at the back of the horizon glass until they coincide.

* If the telescope is not used, hold the instrument horizontal; the true horizon will be seen outside the horizon glass and the reflected in the silvered part of the glass.

With the index clamped at 0, the reflected object should pass immediately over the true object when the tangent screw is slowly moved.

Q. In the absence of a screw how would you proceed?

Ans. Find the index error.

Q. How would you find the index error by the horizon?

Ans. Clamp the index at 0, hold the instrument vertically, and look through the telescope at the horizon to see the true and reflected parts form one line; if they do not, move the tangent screw until they do, the reading is the index error.

Q. How is it to be applied?

Ans. Subtract when on and add when off the arc.

Q. Place the index at error of minutes to be added, clamp it, and leave it.

(NOTE.—The examiner will see that it is correct.)

Q. The Examiner will then place the zero of the vernier on the arc, not near any of the marked divisions, and the Candidate will read it.

NOTE.—In all cases the Applicants will name or otherwise point out the screws used in the various adjustments.

Q. How do you find the index error by the Sun?

Ans. Clamp the index about 32′ on the arc, and look at the sun, two suns will appear, bring their upper and lower limbs in exact contact, and note the reading, then clamp at about 32′ off the arc, making an exact contact as before, note the reading, half the difference of the two readings will be the index error, to be added when the greater reading is off the arc and subtracted when on.

Q. The readings being

What is the index error, and how you apply it?

	32′ 50″	off
	34 30	on
2)	1 40	
	0 50	to subtract

Q. What proof have you that those measurements or angles have been taken with tolerable accuracy?

Ans. The sum of the two readings divided by 4 should be equal to the sun's semi-diameter that day.

FOURTH ADJUSTMENT.

At some ports the fourth adjustment may be asked by the Examiner.

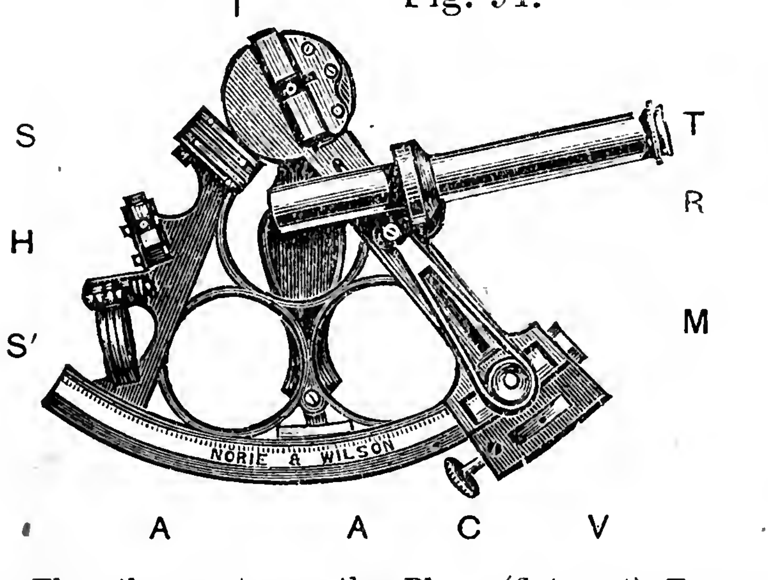
Q. What is the fourth adjustment?

Ans. To set the axis of the telescope (or line of collimation) parallel to the plane of the sextant.

Q. Describe how you would make the fourth adjustment.

Ans. Screw in the inverting telescope until two of the threads or wires are parallel to the plane of the instrument; select two stars or any two celestial objects about 90° or more apart, slide the vernier along the arc and bring the two objects in exact contact on one of the wires, then, with a slight movement of the instrument, shift them on to the other wire; if the contact remains the same the adjustment is correct; if not, move the upper and lower screw in the double collar, slackening one and tightening the other, until the objects remain in contact on both the wires.

Fig. 94.



A = Arc.
H = Horizon Glass.
R = Telescope Ring.
M = Microscope.
S = Index Shades.
C = Tangent Screw.
I = Index Glass.
T = Inverting Telescope.
V = Vernier.
S′ = Horizon Shades.

The other parts are the Plane (flat part), Tangent Screw (under Vernier), 1st Adjustment Screws, 2nd Adjustment Screw and 3rd Adjustment Screw. The Adjustment Screws are visible in the figure. For further information on the adjustments of the Sextant, see Norie's Epitome.

STEAMSHIPS TOWING.

A steamship towing is subject to the Rule of the Road, the same as other steam vessels under way, also the vessels being towed as they are propelled by machinery.

These vessels will have to keep clear when they have other steam vessels on their own starboard side (Art. 19).

Articles 21 (*note*) and 27 will often have to be obeyed in this case.

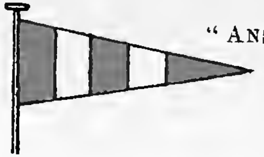
REGULATIONS AS TO CHOLERA, YELLOW FEVER AND PLAGUE.

Night signal added.—A night signal has been added to Article 25 of the Local Government Board Regulations, and the Article now reads as follows:—" Article " 25. The Master of every ship infected with cholera, " yellow fever, or plague shall, when the ship is with- " in 3 miles of the coast of any part of England or " Wales, or is within the limits of a port, cause to be " hoisted—(1) At the masthead or where it can be best " seen, during the whole of the time between sunrise " and sunset, a day signal, consisting of a large flag of " *yellow* and *black* borne quarterly (flag L); or (2) At " the peak or other conspicuous place where it can best " be seen, and at a height of not less than 20 feet above " the hull of the ship during the whole of the time " between sunset and sunrise, a night signal, consist- " ing of 3 Lights, which shall be arranged at a distance " of not less than 6 feet apart, in the form of an equila- " teral triangle, and of which the light at the apex of " the triangle shall be *white*, and the other Lights at " the ends of the base of the triangle shall be *red* in " colour.

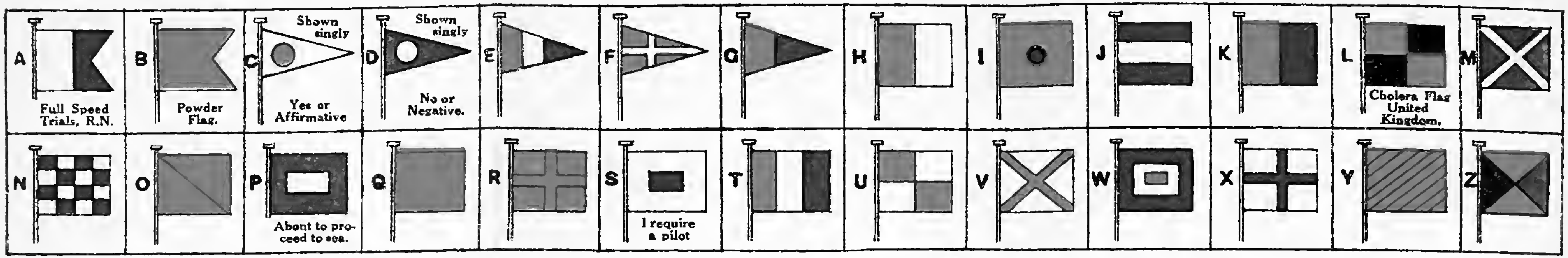
" No person (other than an officer of Customs or a " person acting in the execution of this order) shall " leave the aforesaid ship until after such visit of the " Officer of Customs, as is mentioned in Article 2, or " until after the visit of the Medical Officer of Health " in pursuance of Article 8."

FLAGS OF THE COMMERCIAL CODE OF SIGNALS, FOR THE USE OF ALL NATIONS.

"CODE SIGNAL" AND "ANSWERING PENNANT."



N.B.—When used as the "Code Signal," this Pennant is to be hoisted under the "Ensign;" when used as the "Answering Pennant," where best seen.

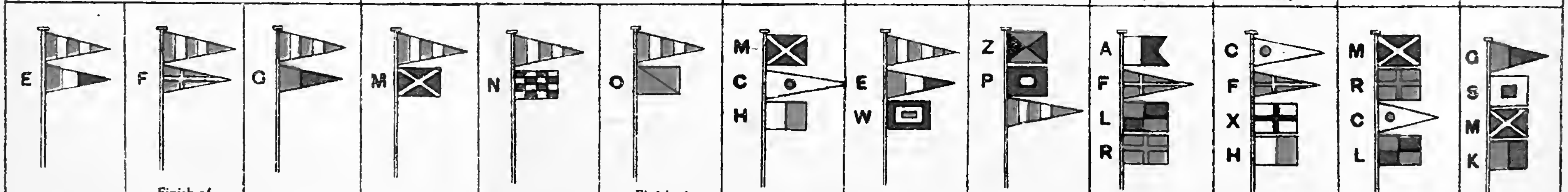


The following examples will serve to illustrate how the *form of a hoist* will usually denote the *nature of the signal* made :—

Code Flag over one flag is an urgent signal. One flag held in hand over gunwhale is for vessels towing or being towed. Two flag signals are urgent signals.

Three flag signals relate to :—Compass, Money, Weights and Measures, Decimals and Fractions, Auxiliary Phrases, and all ordinary signals which are found in the General Vocabulary Three flags with code pennant on top or below, are special signals. (See below)

TO BE FOUND AT THE BEGINNING OF SIGNAL.						MIDDLE.	Will be found at the latter end of Part 1. (SIGNAL BOOK)					
CODE FLAG OVER ONE FLAG.						THREE FLAGS.			FOUR FLAGS.			
Alphabetical (Spelling) Signals.			Numeral Signals			Ordinary Signal General vocabulary.	Code Flag over two Lat. Long. Time Bar. & Ther.	Code Flag under two Alternative Numeral Table.	A or B uppermost Geo-graphical Signals.	C uppermost Alternative Spelling Table	Square Flag uppermost Merchant Ships.	G uppermost Men-of-War.
No. 1	No. 2	No. 3	No. 1	No. 2	No. 3							
E	F	G	M	N	O	M C H	E W	Z P	A F L R	C F X H	M R C L	G S M K
Going to Spell.	Finish of word or initial.	Finished spelling.	Going to hoist a number.	Decimal point.	Finished making numbers.	Engines broken down.	38° Long.	500,000	Sunderland	Ciz	Cairnavon of Newcastle.	Magnificent (Bat.) 16 guns.



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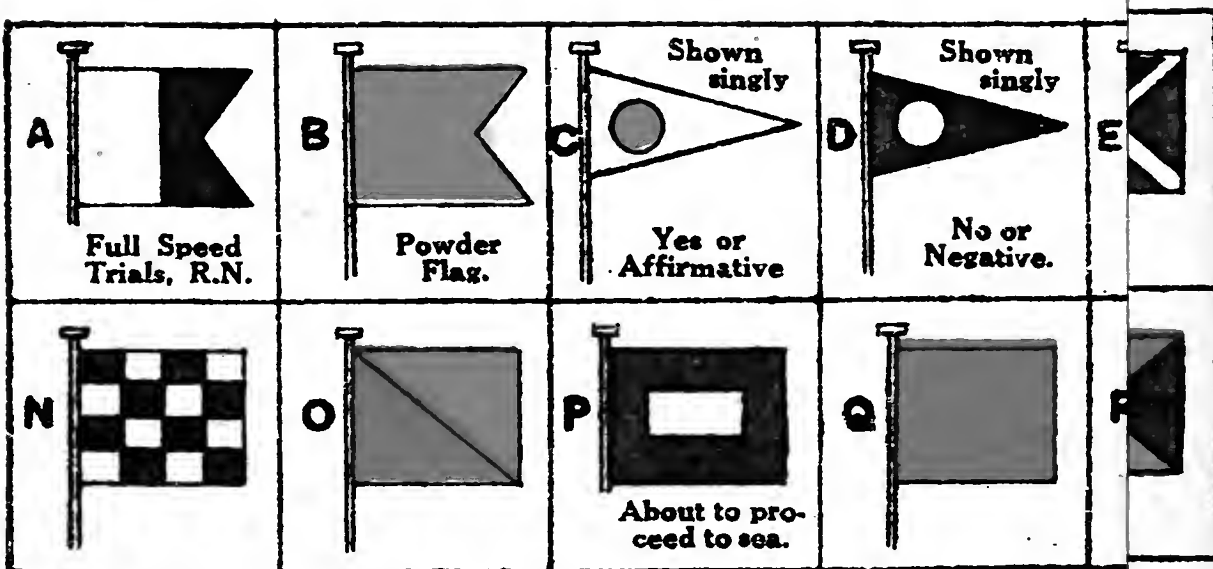


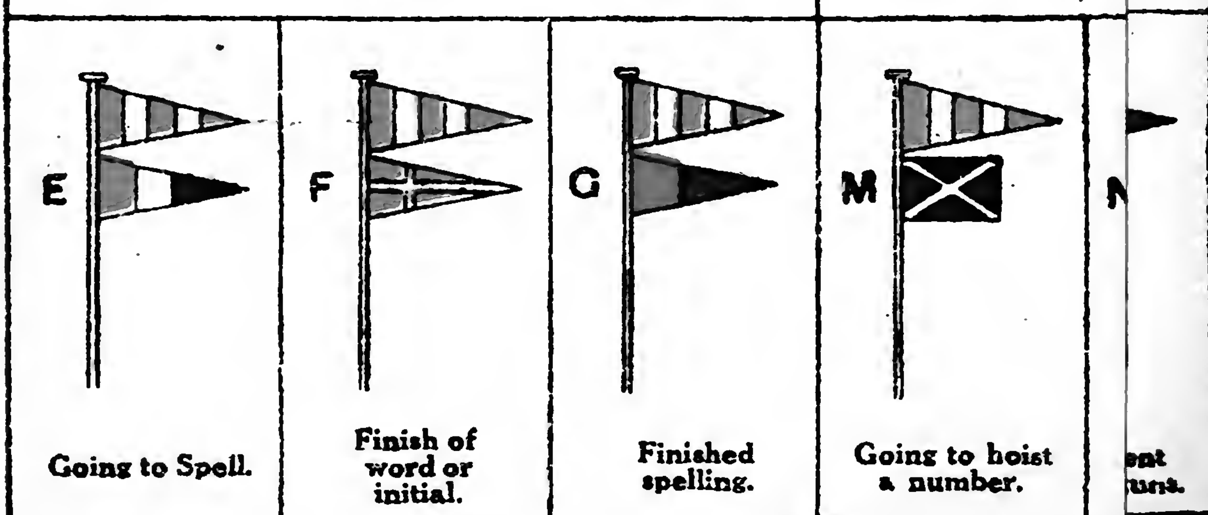
The following examples will serve to illus

Code Flag over one flag is an urgent signal.
whale is for vessels towing or being towed. Two f

TO BE FOUND AT THE BEGINNING OF SIGN

CODE FLAG OVER ONE FLAG

Alphabetical (Spelling) Signals.			Nu	st Var.
No. 1	No. 2	No. 3	No. 1	



PUBLISHED BY THOMA

THE COMMERCIAL CODE OF SIGNALS.

In reading any signal there can be no difficulty in finding it in the Signal Book, as the flags are all arranged in *alphabetical* order, from the beginning to the end of the book. *One* flag signals *first*, *two* flag signals *next*, *three* flag signals *third*, *four* flag signals *last*.

Men of War and Merchant Ship's names are found in the "British Code List," which is a separate book from the "International Code of Signals."

* MAKING SIGNALS, (Part I).

Spelling words page 6, or from spelling table	page 516
Numeral signals page 7, or from Numeral table	,, 421
Signals for vessels towing or being towed	,, 8
Urgent and Important Signals (Code flag over one flag)	,, 9
Urgent and Important Signals *(two flags)*	pages 10 to 19

Three Flags:—

Compass signals in degrees and points,	pages 20 and 21
Money	,, 22 to 25
Measures & Weights of different Countries	,, 26 to 31
Decimals and Fractions	page 32
Metrical Weights, etc., and their British equivalents	,, 32 and 33
Auxiliary Phrases, such as: Am I not; They are not; Could or might not be; I should have been; If you do, etc.	,, 34 to 63

NOTE.—Urgent signals, money, weights and measures, and auxiliary phrases can be found in the general vocabulary the same as ordinary signals.

Three Flags:—

General vocabulary—where all ordinary signals are made and read ...	pages 64 to 414
Latitude and Longitude ...	pages 415 and 416
Hours, minutes, and seconds of time	,, 417
Barometer and Thermometer ...	,, 418 to 420
Numeral Table	,, 421

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* All numbers of Pages and Diagrams under this heading refer to the Signal Book.

Four Flags:—

Geographical Signals (to read them)	pages	422 to 467
,, ,, (to make them)	,,	468 to 515b
Alphabetical Spelling Table ...	,,	516 to 534

Distant, Semaphore and Morse Code signals, Part II.

Ships' names and Men of War are read from the "British Code List," which is a separate book.

HINTS ON MAKING SIGNALS.

1. All the sentences and parts of a sentence in the "General Vocabulary" will be found under the principal word in the sentence, as all the words are arranged in alphabetical order, and the sentences where these words are in will be found under that particular word.

Rule.—To find any word or sentence.

Look for the principal word in the sentence, and under that word will be found the signal required. If it cannot be got under one word, try another.

2. In the middle of the "Signal Book" will be found a piece of green tape, and when the book is opened to this place, the index for all the different kinds of signals will be seen at pages 272 and 273.

Note.—All candidates should be able to turn to any particular signal without the aid of this index.

3. Code Flag Signal over E indicates—A word is going to be spelt.

,,	,,	F	,,	—Finish of word, or dot between initials.
,,	,,	G	,,	—Spelling finished.
,,	,,	M	,,	—A number is going to be hoist.
,,	,,	N	,,	—A decimal point.
,,	,,	O	,,	—Numbers finished.
,,	,,	Any one Flag indicates—Urgent Signal.		

A flag held in the hand above the gunwale indicates an urgent Signal, between vessels towing or being towed.

4. Code Flag over two flags indicates latitude, longitude, hours; minutes, and seconds of time and arc; barometer and thermometer.

5. Code Flag under two flags indicates alternative numeral table.

Note.—All special Signals are at the beginning or end of the book, and the ordinary Signals which are found in the Vocabulary will be either two or three flag Signals without the Code Flag.

6. When another ship is signalling you, keep the Answering Pennant flying; "close up" when you understand, and at the dip ($\frac{2}{3}$ of the way up) when waiting for the next signal.

EXAMPLES.

Note.—In spelling or making numbers, there must not be more than four flags in a hoist and the same flag cannot occur twice in a hoist.

1. Spell—Charles Brown.

METHOD I. (Page 6.)

1st.—Code Flag over E = Going to spell.

2nd.—CHAR } = Charles.
3rd.—LES }

4th.—Code Flag over F = Finish of word.

5th.—BRO } = Brown.
6th.—WN }

7th.—Code Flag over G = Finished spelling.

METHOD II. (Page 516.)

1st. —CFTK = Cha }
2nd.—CTYZ = rl } Charles
3rd. —CJFX = es }

4th.—Code Flag over F.

5th.—CFMH = Bro } Brown
6th.—CZFR = wn }

2. 1903.

METHOD I. (Page 7.)

1st.—Code Flag over M = Going to make a number.
2nd.—AIUC = 1903.
3rd.—Code Flag over 0 = Finish of numbers.

METHOD II. (Page 421.)

1st.—Code Flag under		YJ	=	1000
2nd.—	,,	YI	=	900
3rd.—	,,	UD	=	3
				1903

3. N 28° E = ACG.
4. Dollar = ATJ.
5. Gallon = AYW.
6. ·01 or $\frac{1}{100}$ = BCP.
7. They are from (Auxiliary phrase) = BET.
8. Engines broken down, I am disabled = BJ, which can be found under Broke—n, also Disable—ing —ility.
9. Deepest water is nearer the shore = KQV, which can be found under; Water, Shore (the shore), Near—ed—ing, Deep—en—ed—ing.

10.	37° Latitude	=	Code Flag over BO.
11.	Long. 136°	=	,, ,, IU.
12.	21 hours	=	,, ,, LM.
13.	30 seconds	=	,, ,, PG.
14.	59 minutes	=	,, ,, NZ.
15.	28° Fah.	=	,, ,, VI.
16.	29·0 inches (Bar)		,, ,, RT.
17.	90,000	=	,, under ZK.
18.	Dungeness	=	AELB.
19.	Quebec	=	BDTA.
20.	GSMW	=	Mars, tw, sc, bat, sh.
21.	KVGW	=	Cyrene of Sunderland.

DISTANT AND SEMAPHORE SIGNALS.

Part II.

1. Whenever a ship is becalmed or too far off to distinguish flags, Distant or Semaphore signals will have to be resorted to. There are several methods, the three principal being:—

(*a*) By Cones, Balls and Drums.
(*b*) By Balls, Square Flags, Pennants and Whefts.
(*c*) By the Fixed Coast Semaphore.

2. Distant Signals are made from a ship by hoisting shapes, and from the shore by shapes or semaphore.

(*a*) The shapes used are:—

A Cone point upwards; A Ball; A Cone point downwards and a Drum.

(*b*) A square flag may be substituted for the cone point upwards.

A Ball.

A pennant may be substituted for the cone point downwards, and a pennant with the fly tied to the halyards, or a wheft for a drum (a wheft is any flag tied in the centre).

(*c*) In signalling by the Semaphore, the position of the arms represents the shapes.

3. To simplify the method of making and reading the above signals, the four positions of the arms and the four shapes have been numbered 1, 2, 3, 4. (See Plates I., II., III., IV., V., and VI.)

2. represents the "Preparative," "Answering," or "Stop" after each complete signal.

2. 2.	represents	Annul the whole signal.
1. 1. 2.	,,	A
2. 1. 2.	,,	I
2. 3. 3.	,,	Q
4. 2. 1.	,,	Code Flag Sign.
4. 2. 2.	,,	Alphabetical Sign.
etc., etc.		

The *disc* at the top of the Semaphore must be shown until the signal is completed.

The *indicator* at the bottom will distinguish No. 2 from No. 4.

4. Any signal that can be made by flags from Part I. can also be made by Distant or Semaphore.

The Code Flag Sign, Alphabetical Sign, Numeral Sign, as the case may be, must always be hoisted first.

Example 1.—QDS in Part I. means "How does the land bear?" Make the same by Distant or Semaphore.

Code Flag Sign	Q	D	S	Stop
4.2.1.	2.3.3.	1.2.3.	2.4.1.	2.

Example 2.—AFLR from Part I. means "Sunderland." Make the same by Distant or Semaphore.

Code Flag Sign	A	F	L	R	Stop
4.2.1.	1.1.2.	1.3.2.	2.2.1.	2.3.4.	2.

Example 3.—Spell "Oliver."

Alphabetical Sign	O	L	I	V	E	R	Finishing Sign
4.2.2.	2.3.1.	2.2.1.	2.1.2.	3.1.2.	1.2.4.	2.3.4.	4.3.2.

Example 4.—Make number 1893.

Numeral Sign	A	H	I	C	Finishing Sign
4.2.3.	1.1.2.	2.1.1.	2.1.2.	1.2.2.	4.3.2.
	1	8	9	3	

5. There are thirty-seven "Special Distant Signals" that can be made with one hoist only (See Signal Book, Part II., pages 541 to 547). These signals are not preceded by the Code Flag Sign, but in all cases the stop must immediately follow the hoist.

Example 1.—2.4.3. with 2. (stop) immediately following will be found to mean "Cyclone, Hurricane, or Typhoon expected."

Example 2.—2.2.3. followed by 2. (stop) will be found to mean "Want a tug; can I obtain one?"

ADDITIONAL METHODS OF SEMAPHORING.

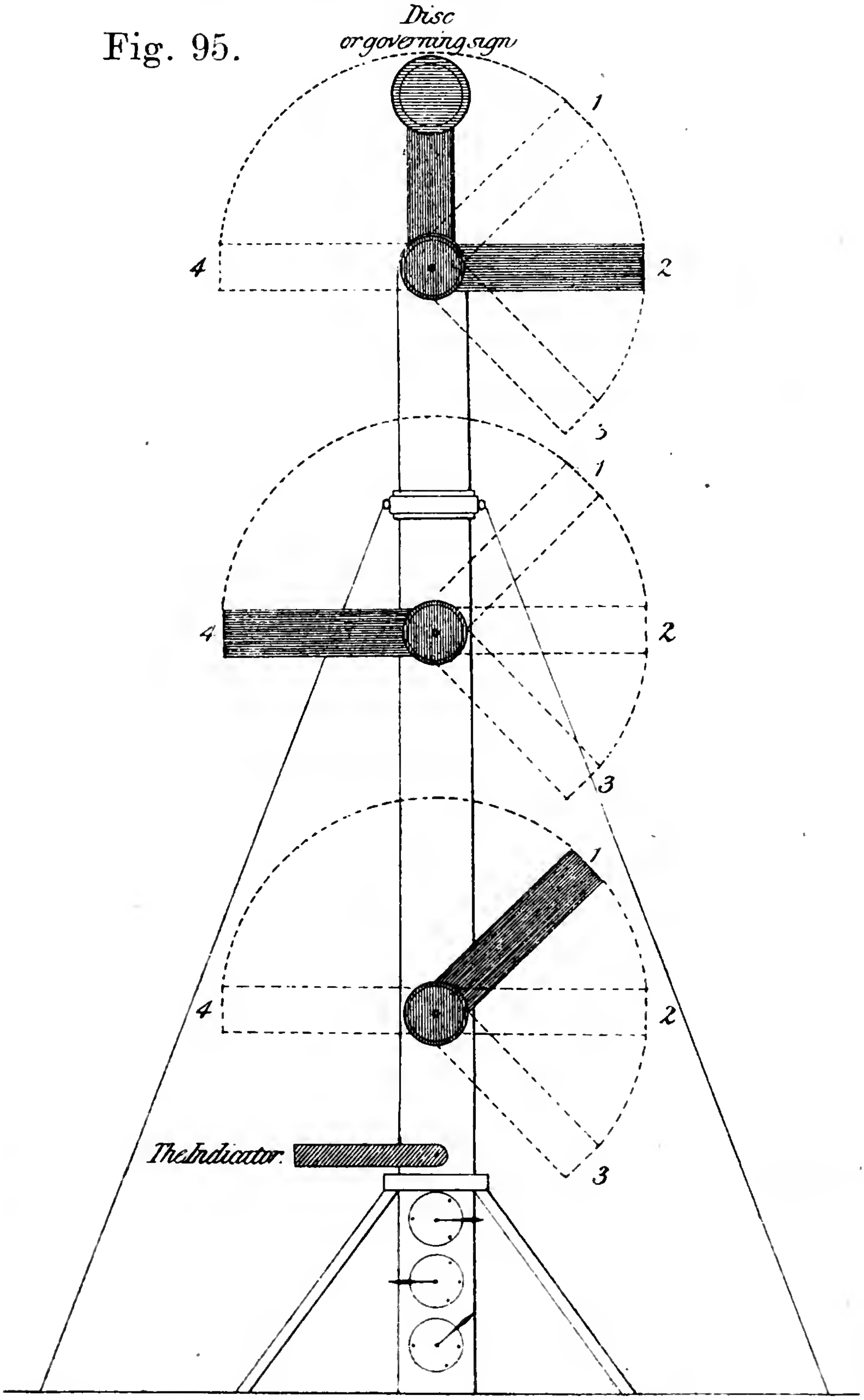
To signal by the methods on Plates VII., VIII., and IX., Part I. of the Signal Book is not required. All communications will be made by spelling, and should a number be required, the Semaphore will have to be put at the numeral sign and the number made. After the numeral signal is finished, the alphabetical sign is to be made and the communication by spelling proceeded with.

DIAGRAMS.

The following plates are taken from the Signal Book, which is supplied to the Candidate when being examined in Signals.

PLATE I.—FIXED SEMAPHORE FOR COAST SIGNALLING.

Fig. 95.

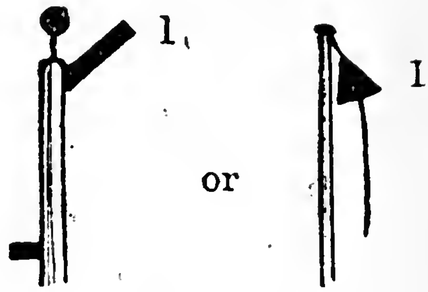


The signal shown on the Semaphore is 2, 4, 1.

PLATE IV.

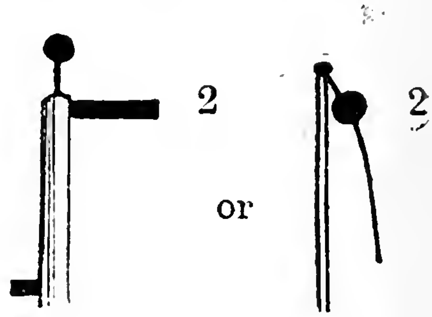
1 representing the Semaphore Arm pointing upwards, on the *opposite* side to the indicator, a Cone with the point upwards, or a square Flag.

Indicator.



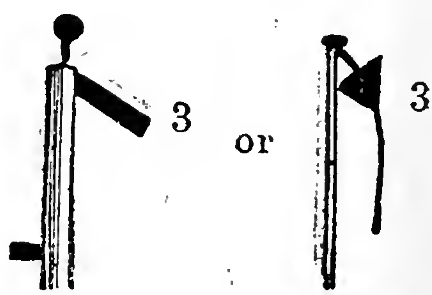
2 representing the Semaphore Arm pointing horizontally, on the *opposite* side to the indicator, or a Ball.

Indicator.



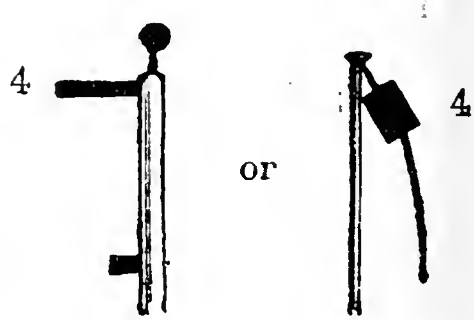
3 representing the Semaphore Arm pointing downwards on the *opposite* side to the indicator, a Cone with the point downwards, or a Pennant.

Indicator.



4 representing the Semaphore Arm pointing horizontally on the *same* side as the indicator, a Drum or a Pennant with the fly tied to the halyards or a Wheft.

Indicator.



The stop signal is to be made at the end of each complete signal.

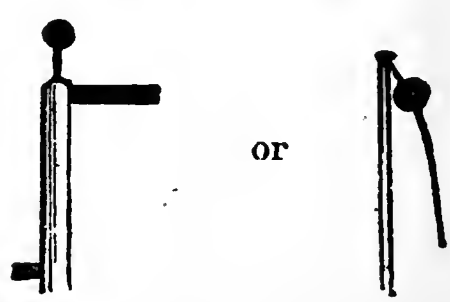


PLATE II.—GENERAL ALPHABETICAL TABLE FOR MAKING THE INTERNATIONAL CODE ... FIXED SEMAPHORE.

E 1.2.4	M 2.2.3	U 2.4.3	Alphabetical Sign 4.2.2
F 1.3.2	N 2.2.4	V 3.1.2	Numeral Sign 4.2.3
G 1.4.2	O 2.3.1	W 3.2.1	Finishing Sign after Completion of word or number, when spelling, or making numeral signals 4.3.2
H 2.1.1	P 2.3.2	X 3.2.2	

If no Cones are available, a square Flag may be substituted for the Cone point upwards, a Pennant for the Cone point downwards, and a wheft for the Drum.

E 1. 2. 4	M 2. 2. 3	U 2. 4. 3	Alphabetical Sign 4. 2. 2
F 1. 3. 2	N 2 2 4	V 3 1. 2.	Numeral Sign 4. 2. 3
G 1. 4. 2	O 2 3 1	W 3. 2. 1	Finishing Sign after Completion of word or number, when spelling, or making numeral signals 4. 3. 2
H 2. 1. 1	P 2. 3. 2	X 3. 2. 2	

If no Cones are available, a square Flag may be substituted for the Cone point upwards, a Pennant for the Cone point downwards, and a wheft for the Drum.

PLATE III.—GENERAL ALPHABETICAL TABLE FOR MAKING THE INTERNATIONAL CODE SIGNALS BY MEANS OF DISTANT SIGNALS BY SHAPES.

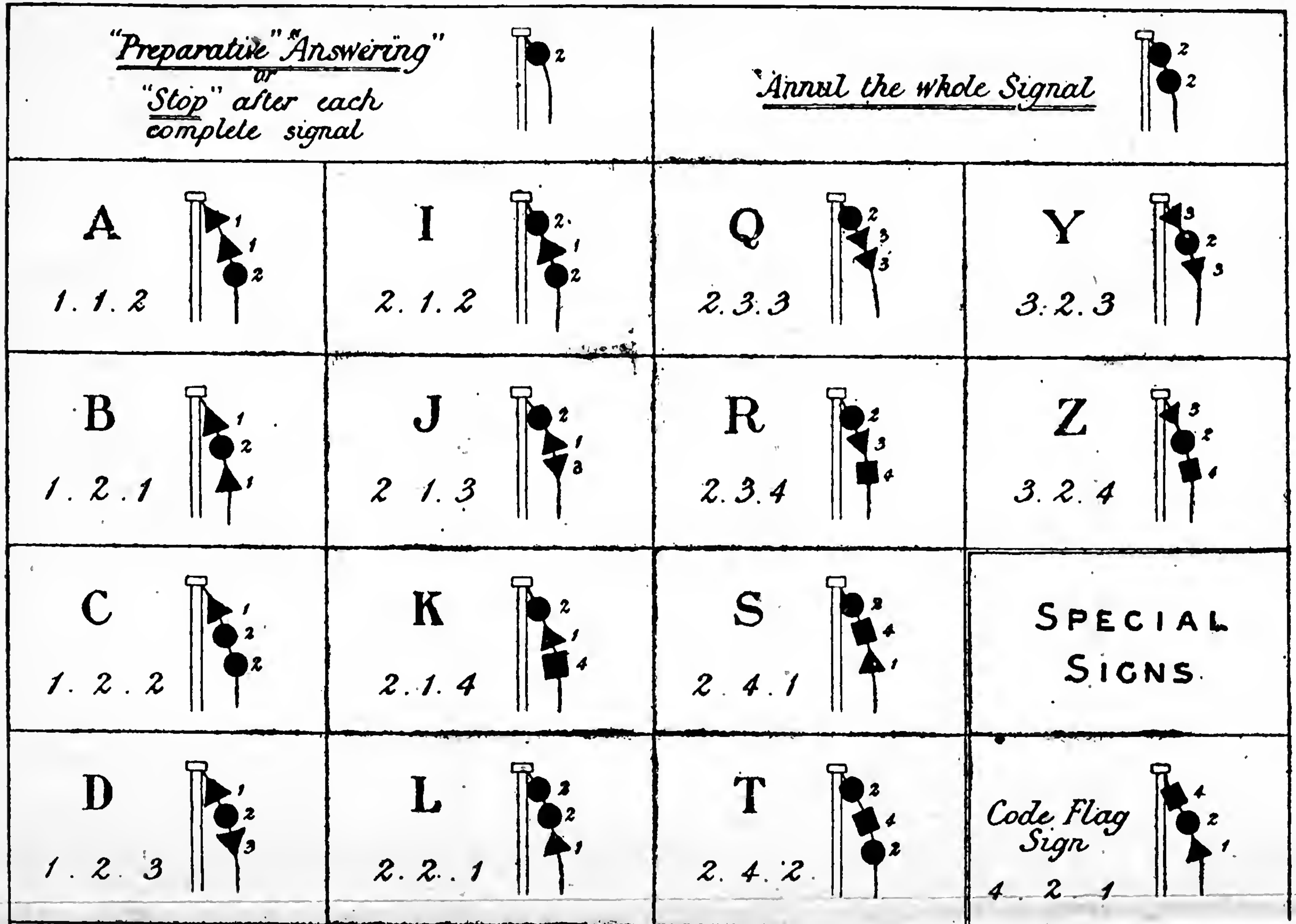
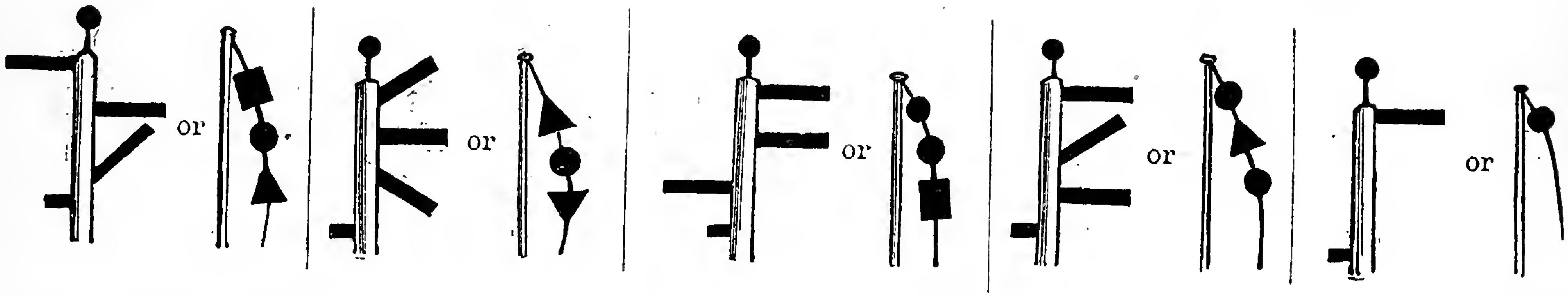


Plate V.—Example of a Signal from the International Code made by Fixed Semaphore or by Distant Signals.



4 2 1—Code Flag Sign, indicating that the Signal which follows is taken from the General Vocabulary of the International Code.

1 2 3—D

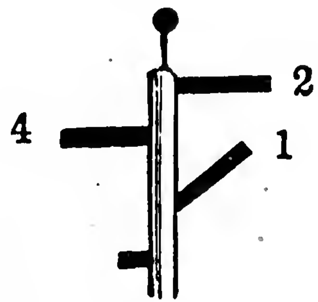
2 2 4—N

2 1 2—I

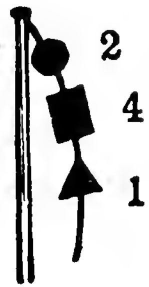
2—Stop, *i.e.*, Signal is ended.

Looking D N I out in the International Code, we find it to be "Pilot boat is advancing towards you."

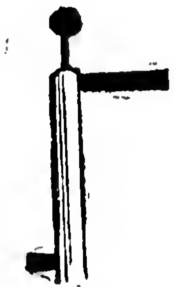
PLATE VI.—EXAMPLE OF A SPECIAL DISTANT SIGNAL MADE BY SEMAPHORE OR DISTANT SIGNALS.



or



2 4 1



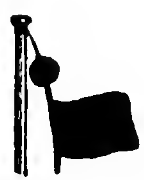
or

Stop

Looking 2 4 1 out in the Table of Special Distant Signals (page 543), we find it to be "Cannot distinguish your flags; come nearer, or make Distant Signals."

The following Distant Signals made with Flag and Ball, or Pennant and Ball, have the special signification indicated beneath them.

You are running into danger.



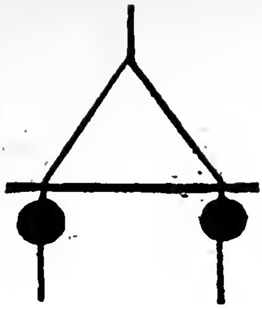
Fire, *or*, Leak; want immediate assistance.*

Short of provisions. Starving.

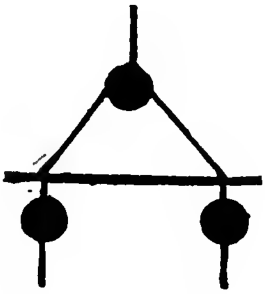
Aground; want immediate assistance.*

Plate VII.

Signals used at Lloyd's Signal Stations.



This signal indicates that the station at which it is hoisted is temporarily closed, and that no communication can be held.*

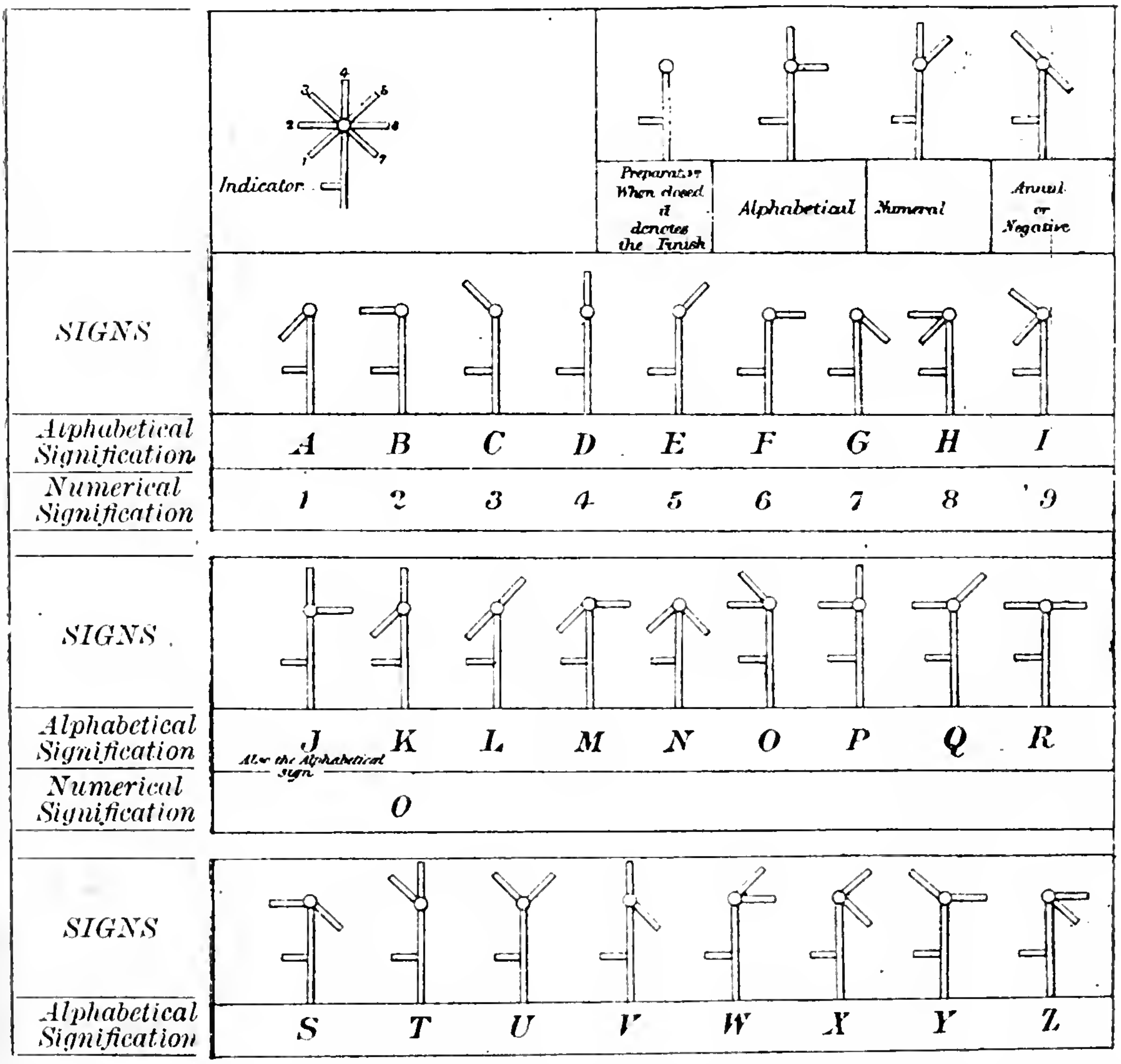


This signal indicates that telegraphic communication is interrupted, and that messages cannot be forwarded by telegraph, but will be forwarded by other means as soon as possible.*

* These signals will be kept up until the signal station is again occupied, or until telegraphic communication is again possible.

The British Moveable Semaphore.

Semaphore Signs. Governing Signs.



Note.—If a numeral signal is to be followed by words; the end of the numerical signification of the signs, is shewn by the Alphabetical sign being made, indicating that spelling is again to commence.

Plate VIII.—British Method of Semaphoring by Hand Flags

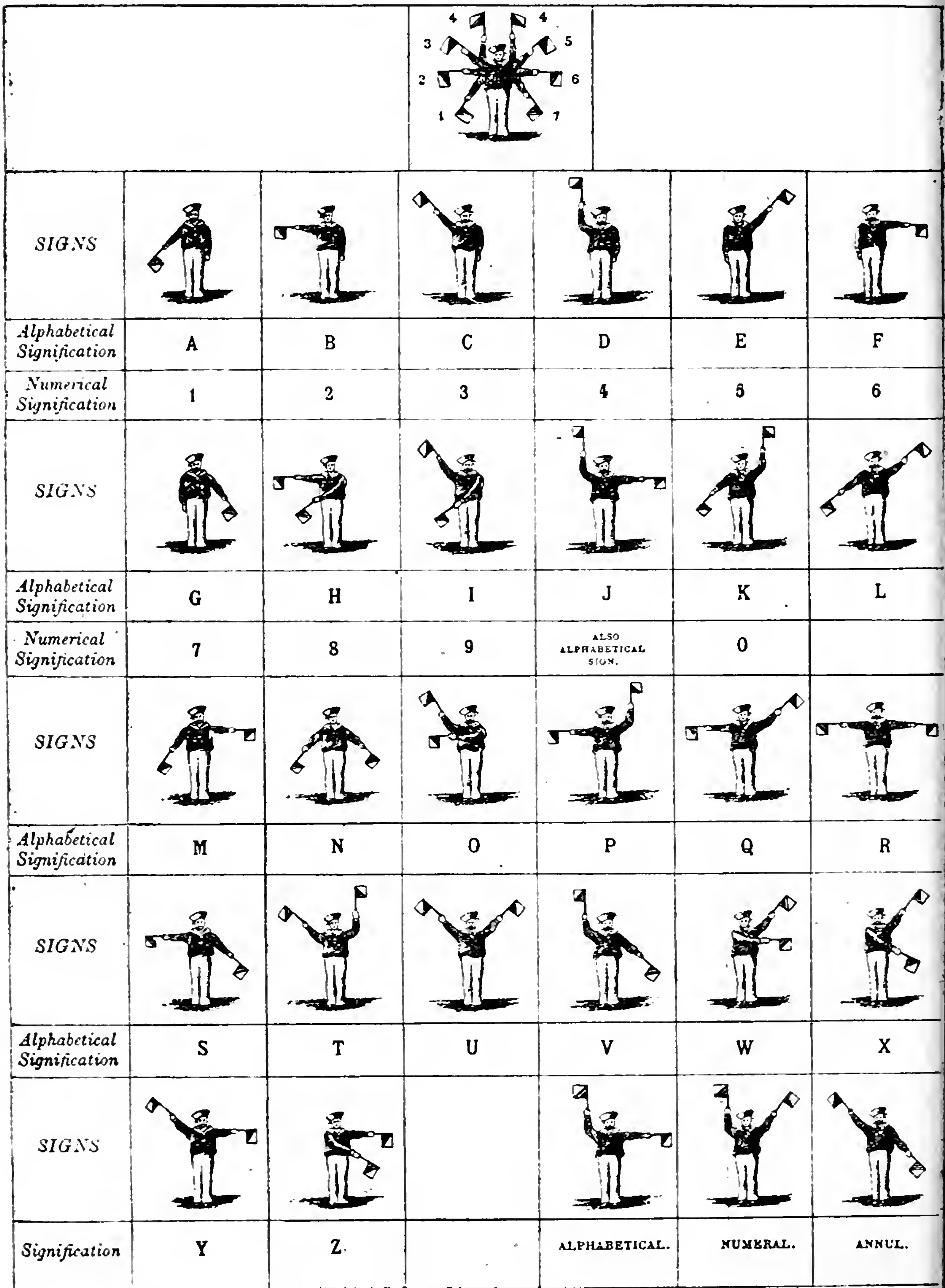
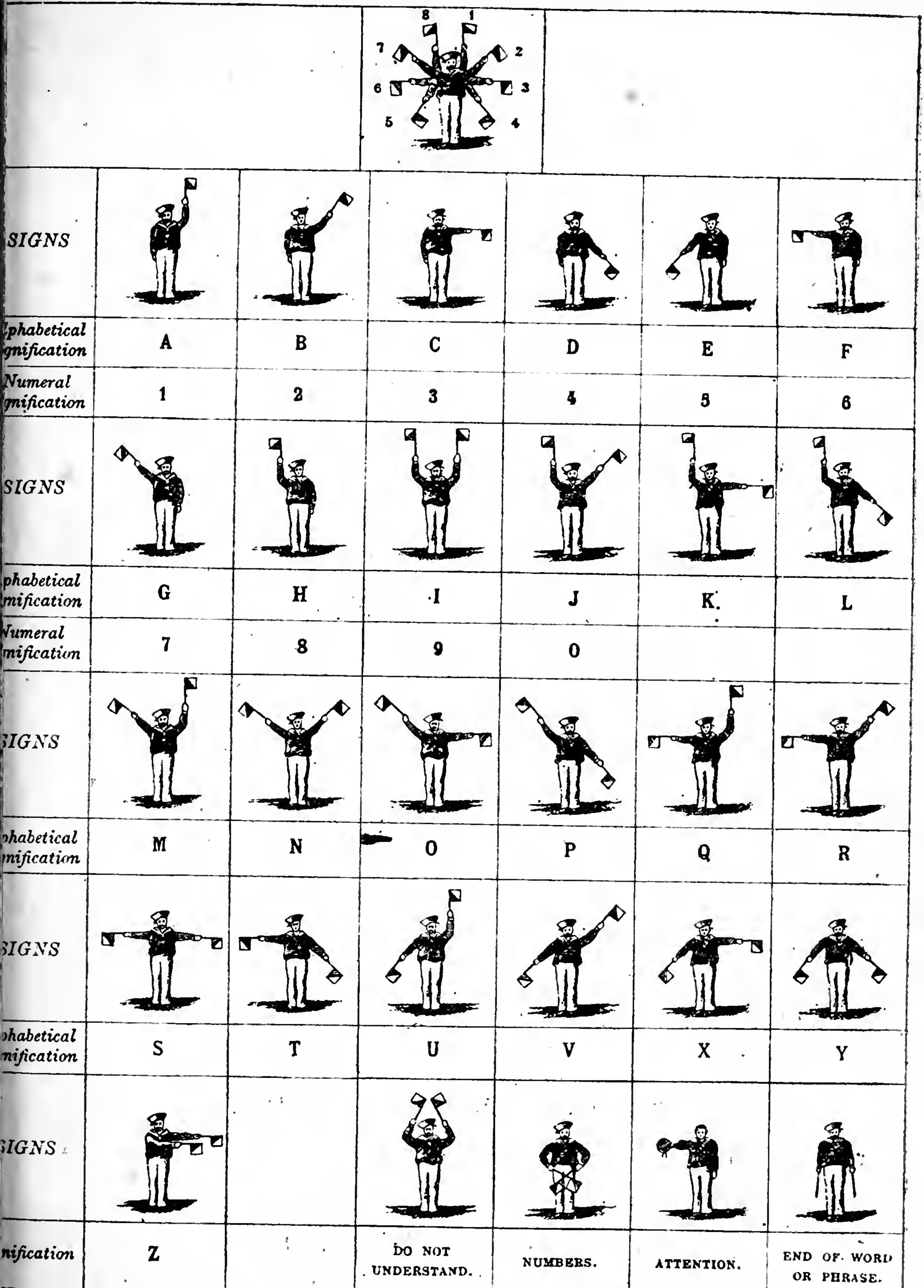


Plate IX.—French Method of Semaphoring by Hand Flags.



Note.—The W is made by means of two consecutive V's.
To indicate the finish of a Numerical Signal the Number sign is again made ; thus the number sign begins and ends Numerical Signals.

THE MORSE CODE.

Flag Waving.

Instructions for communicating by flashing Signals with a Flag (generally termed flag waving).

The system used is the Morse Alphabet, the letters being made by groups of LONG and SHORT flashes caused by moving a flag through a long or short arc, as described below.

The Signalman may work from left to right, or from right to left, as shown in Figures 1 and 2, according to convenience and direction of the wind.

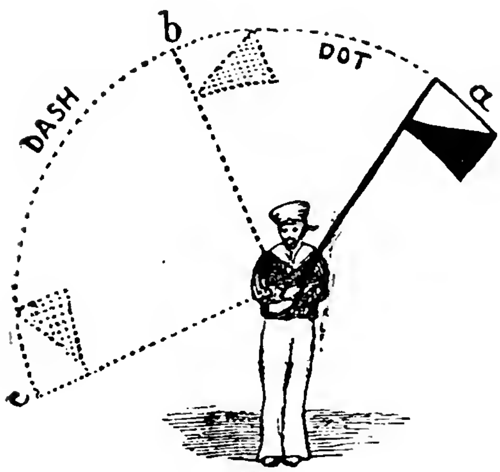


FIGURE 1.

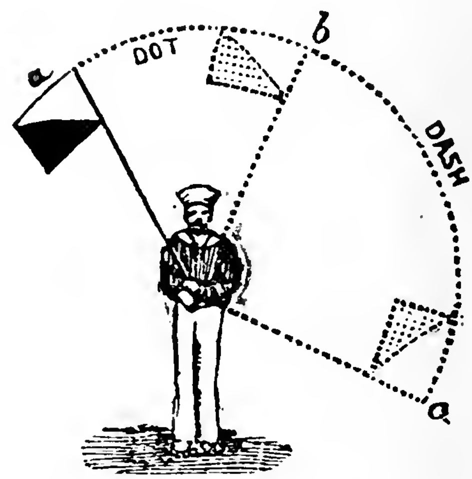


FIGURE 2.

In the normal position (*a*) in the above figures the flag should make an angle of 25° with a vertical line through the centre of the body.

The pole should be kept high enough to permit seeing underneath the flag while in motion.

To make a Short Flash or Dot.

The flag is waved from *a* to *b*, and without any pause back again to the normal position.

To make a Long Flash or Dash.

The flag is waved from *a* to *c*, and after a short but distinct pause at *c*, brought back to the normal position.

When Signalling a Letter.

When signalling a letter the flashes representing it should be made in one continuous wave of the flag, taking particular care that no pause is made when at the normal position.

Example.—To make R ▪ ▬ ▪ wave the flag from *a* to *b* back to *a* and without a pause down to *c*, making there a short but distinct pause (*vide* instructions for long flash), back to *a*, then without a pause to *b* and back to the normal position *a*.

MORSE SIGNAL CHARACTERS.

Light and Sound Signals.

▬ indicates a LONG of about 3 seconds duration.
▪ „ SHORT „ 1 second „

Preparative Signal to attract attention ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ ▪ etc.

Answering Signal, *or*, I understand ▬ ▪ ▬ ▪ ▬ ▪ ▬ ▪ etc.

Interval between each flash or sound . . 1 second
„ „ „ letter . . . . 3 seconds
„ „ „ word . . . . 6 „

A . .	▪ ▬	N . .	▬ ▪
B . .	▬ ▪ ▪ ▪	O . .	▬ ▬ ▬
C . .	▬ ▪ ▬ ▪	P . .	▪ ▬ ▬ ▪
D . .	▬ ▪ ▪	Q . .	▬ ▬ ▪ ▬
E . .	▪	R . .	▪ ▬ ▪
F . .	▪ ▪ ▬ ▪	S . .	▪ ▪ ▪
G . .	▬ ▬ ▪	T . .	▬
H . .	▪ ▪ ▪ ▪	U . .	▪ ▪ ▬
I . .	▪ ▪	V . .	▪ ▪ ▪ ▬
J . .	▪ ▬ ▬ ▬	W . .	▪ ▬ ▬
K . .	▬ ▪ ▬	X . .	▬ ▪ ▪ ▬
L . .	▪ ▬ ▪ ▪	Y . .	▬ ▪ ▬ ▬
M . .	▬ ▬	Z . .	▬ ▬ ▪ ▪

SINGLE LETTER SIGNALS MADE BY FLASHING.

The following letters, when flashed singly and repeated at intervals, without any preceding sign, are contained in the International Code Signal Book, and have urgent meanings:—

To be sent on the lamp or whistle.

U	· · —	You are standing into danger.
V	· · · —	I want assistance, remain by me.
W	· — —	Have encountered ice.
P	· — — ·	Your lights are out, or want trimming.
R	· — ·	The way is off my ship, you may feel your way past me.
L	· — · ·	Stop, or heave to, I have something important to communicate.
F	· · — ·	Am disabled, communicate with me.

FOR VESSELS TOWING OR BEING TOWED.

To be sent by flashes on the lamp.

·	Steer more to starboard.
· ·	Steer more to port.
· · · ·	Cast off hawsers.

PROCEDURE OF ANSWERING THE SEARCHLIGHT BY DAYLIGHT.

In the event of one of His Majesty's ships calling up a merchant ship or signal station in *Daylight* by means of the Searchlight (a method which may be employed when distance renders it impracticable to read flags or semaphore), the merchant ship or signal station should use the Answering pendant (Code flag) in the following manner—

To be hoisted at the "dip" when the call is observed, and close up when ready to read the signals which will follow. To be dipped when a word or group is missed; the man-of-war will then repeat slowly the last part of the message made, until the Answering pendant is hoisted close up again.

BRITISH SIGNAL MANUAL.

Candidates for all Certificates have to understand this book from beginning to end; to be had from all nautical booksellers (price 6d.).

QUESTIONS RELATING TO CYCLONES. FOR MATES AND MASTERS.

(See page 62.)

These questions are now discontinued, but they are here retained as they all come in the meteorological questions.

Q. The direction of the wind in a cyclone being* South; state the probable bearing of its centre from the ship in the Southern Hemisphere.

Ans. The probable bearing of its centre would be between NE and East. NE when the storm begins; ENE when the barometer falls three-tenths of an inch, and East when the barometer falls six-tenths of an inch.

Q. And suppose that the wind during the passage of the same cyclone were found to change towards the* SE, what would be the ship's position with reference to the line of progression of the centre of the cyclone, and what action would you take?

Ans. The ship would be on the left-hand side of the line of progression, and I should heave to one port tack (if necessary). On this tack she will come up and bow the sea, and is not likely to be caught aback.

Q. Under what conditions would the change in the direction of the wind in the cyclone be the reverse of the above?

Ans. If the ship were in the opposite semi-circle, or on the same side going faster than the cyclone in the same direction.

---

* These spaces to be filled by the Examiners, and frequently varied.

Q. What are the usual indications of a ship being on the line of progression of the centre of a cyclone?

Ans. Barometer falling, sea getting worse, wind increasing in violence but never changing, and threatening appearance of the weather.

Q. What are the usual indications that a ship is (*a*) approaching the centre of a cyclone, (*b*) receding from it?

Ans. (*a*) Barometer falling; tempestuous seas getting worse; wind of hurricane force increasing in violence and changing at short intervals; terrific squalls, and threatening appearance of worse weather. (*b*) Barometer rising; sea still dangerous; wind abating and appearance of better weather.

Q. Describe the track usually taken by cyclones in the † , and state the seasons of the year in which they most frequently occur in that region.

North Atlantic and West Indies.

They begin in about 10° N and travel in a W N W and N W direction towards the West Indies, recurving in about 30° N, and proceeding towards the N E, sometimes as far as Europe. Seasons, July to November.

Note.—Cyclones in the North Pacific travel the same as in the North Atlantic, beginning and recurving in about the same Latitudes, the seasons being also the same.

China Sea.

The tracks are generally between West and N W, some recurving to the N E. They may occur any month, but are most frequent between July and November.

Arabian Sea and Bay of Bengal.

The tracks are generally towards the W N W and NW, recurving to the NE in the higher Latitudes. Seasons, April, May, June, and again in October and November.

† The Examiners to fill in whether North Atlantic, Bay of Bengal, China Sea, Indian Ocean, &c., &c.

South Indian Ocean and Mauritius.

They begin in about 10° S and travel in a WSW and SW direction towards the Mauritius, recurving in about 25° S, and proceeding towards the SE. Seasons, November to May.

NOTE.—Cyclones in the South Pacific travel the same as in the South Indian Ocean, beginning and recurving in about the same Latitudes. Seasons, December to March.

Rule for Question 1.

Allow 8 to 12 points to the right of the bearing in the Northern Hemisphere, and to the left in the Southern Hemisphere. 12 points when the storm begins; about 10 points when the barometer falls $\frac{3}{10}$ of an inch, and 8 points when the barometer falls $\frac{6}{10}$ of an inch.

Rule for Question 2.

If the wind change to the right in either hemisphere, the ship will be in the right hand semi-circle, and you heave to on the starboard tack (if necessary). If the wind change to the left, the ship will be in the left hand semi-circle, and you heave to on the port tack (if necessary).

When the ship is hove to on the correct tack, she comes to and bows the sea as the wind changes.

If it is possible to run, run with the wind on the starboard quarter in the Northern Hemisphere and on the port quarter in the Southern Hemisphere, unless the ship is in the dangerous semi-circle. The dangerous semi-circle in the Northern Hemisphere is the right hand semi-circle, and in the Southern Hemisphere the left hand semi-circle.

On the approach of tropical storms there is usually a cessation of the diurnal range, also an unsteady barometer.

For further information on Cyclones see "Reed's New Guide Book."

METEOROLOGY.

Definitions.

1. **Atmosphere.** An aerial ocean completely surrounding the Earth, consisting principally of nitrogen and oxygen intimately mixed with aqueous vapour.

2. **Cyclone.** An area of low pressure surrounded by high, usually called a cyclonic depression.

3. **Anticyclone.** An area of high pressure surrounded by low.

4. **Temperature.** The degree of intensity of the sensible heat of a body.

5. **Conduction.** Transmission of heat through contact with a warmer body.

6. **Convexion.** Transference of heat from one locality to another through the agency of warm currents and warm winds, also from warm air ascending and colder air flowing in to take its place.

7. **Radiation.** Heat which is sent out in straight lines from a warm or hot body, as heat from a fire or the direct rays of the sun.

8. **Wind.** Air in motion caused by the difference of barometrical pressure between two adjacent areas.

9. **Humidity.** Minute particles of water floating between the molecules of the dry air.

10. **Vaporisation.** The conversion of a liquid into a gaseous state, usually by heating or other artificial means.

11. **Evaporation.** The slow conversion of any liquid into vapour by the natural temperature and dryness of the air.

12. **Latent heat.** Heat absorbed by the moisture or aqueous vapour in the atmosphere. This heat is not lost, but hidden, and will reappear when the vapour is restored to its liquid state.

13. **Cloud.** Minute spherical drops of water, which have lost their gaseous state by being cooled below the point of saturation. Cloud is the condensation of invisible water-vapour into visible drops or crystals.

14. **Relative Humidity**. The proportion of aqueous vapour to saturation; or the amount of vapour in the air referred to a scale of 0 to 100, where 0 represents dry air and 100 saturation.

15. **Elastic Force of Vapour**. The pressure of aqueous vapour in the atmosphere; it has not so much pressure as dry air, as volume for volume, aqueous vapour is only five-eighths the weight of dry air.

16. **Isobars**. Lines of equal barometrical pressure on maps or charts.

17. **Isotherms**. Lines of equal temperature drawn on maps of charts.

18. **Pressure Gradient**. The difference of pressure expressed in hundreths of an inch of the barometer readings for 15 miles of distance.

19. **Gradient Wind**. The velocity of the wind calculated from the gradient; it seldom agrees with the observed velocity.

20. **Direction of Clouds**. Clouds near the surface of the Earth usually move in the same direction as the wind. The upper clouds rarely move in the same direction as the surface wind; the angle between them may be 90° or much more.

21. **Trough**. A line of lowest barometrical pressure, dividing that part of a depression where the barometer is falling from that part where the barometer is rising. This line is roughly at right angles to the line of progression and passes through the centre of the cyclone.

22. **Mist and Fog**. Mist is water vapour rendered visible by being cooled below the point of saturation. Fog is mist of greater intensity, and both may be regarded as cloud at the earth's surface.

23. **Rain**. Spherical drops of water precipitated from cloud, composed from minute particles of water uniting, after being condensed.

24. **Hail**. Globules of ice, formed from raindrops carried up into the snow region and frozen into hail. True hail is hard and compact, whereas soft hail consists of fine grains of snowlike substances.

25. **Snow.** Ice crystals of great delicacy and beauty, assuming the form of a six pointed star. These crystals are formed by the condensation of aqueous vapour in a very low temperature on dust particles in the air.

26. **Sleet.** A mixture of rain and snow in the form of small needles pressed together in a confused manner.

27. **Diffraction.** The bending of rays of light when passing an opaque body.

28. **Refraction.** The bending of rays of light whilst passing through different densities of air.

29. **Wedge or Ridge.** An area belonging to an anti-cyclone which is wedged between two cyclones following each other.

30. **Backing.** Wind changing to the left or against the hands of a watch in either hemisphere.

31. **Veering.** Wind shifting to the right or with the hands of a watch in either hemisphere.

32. **Secondary Depression.** A satellite depression thrown out in the form of a loop or kink from a primary depression. There are different kinds, some are " V " shaped and others assume such large proportions that it is difficult to tell which is the primary.

33. **" V " Shaped Depression.** The type of secondary depression which projects out of the southern segment of a cyclone, and is so called because the contour of the isobars form a V.

34. **Gusts.** A sudden and transient increase in the force of the wind, caused by the mixing of cold and warm currents of air.

35. **Squalls.** A squall is a gust of greater intensity and longer duration. Gusts and squalls may occur in calms or light airs, and are also associated with gales and hurricanes.

36. **Doldrums.** A belt of variable winds and calms, between the NE and SE trades. In these regions gusts, squalls, and torrential rains are experienced.

37. **Clearing Showers.** The heavy copious showers of rain accompanied by terrific squalls, immedately in the rear of the trough of a depression.

38. **Line Squall.** A continuous line in a "V" shaped depression where violent squalls are experienced simultaneously as the trough passes over the affected areas. The sudden rise of the barometer along this line are represented on charts by broken lines called a "*fault.*"

39. **Col.** An area of relatively low pressure between two anticyclones, in the form of a neck. The weather in this neck is usually quiet but unsettled with mist or fog and sometimes thunderstorms.

40. **Ice.** Stellate crystals in the form of six pointed stars, frozen solid into a continuous mass from some liquid.

41. **Relegation.** The freezing of two pieces of melting ice when pressed together.

42. **Glaciers.** Rivers of snow or ice.

43. **Icebergs.** Huge masses of ice severed from "glaciers" or from the "great ice barrier."

44. **Ice Barrier** A high cliff of ice in the Antarctic regions extending east and west around the Earth. It is met with in various latitudes to the southward of the parallel of 60°.

DERIVATIONS OF METEOROLOGICAL WORDS.

Barometer—Greek: *Baros*—weight and *Metron*—measure.

Thermometer—Greek: *Therme*—heat and *Metron*—measure.

Hydrometer—Greek: *Hydro*—water and *Metron*—measure.

Hygrometer—Greek: *Hygros*—wet and *Metron*—measure.

Cyclone—Greek: *Kuklos*—To whirl or coil.

Isobar—Greek: *Iso*—equal, *baros*—weight.

Isotherm—Greek: *Iso*—equal, *therme*—heat.

Latent—Latin: *Latere*—to lie hid.

EXAMINATION PAPERS.

The following examination papers have all been given to first mates and masters, when sitting for examination. For more detailed answers to the questions, see the "Seaman's Handbook on Meteorology" also the "Barometer Manual" on the pages given at the end of each question.

Paper I.

Q. Give the causes which disturb the equilibrium of the atmosphere. (P. 20 S.H.)

Ans. The disturbance of the equilibrium of the atmosphere is caused by the unequal barometrical pressure between two adjacent localities. Owing to temperature constantly changing on the earth's surface, the barometrical pressures must also be constantly changing, and the tendency of air is always to flow from areas of high pressures to areas of low.

Q. Why are the localities near the seaboard more equal in climate than the land localities far removed from the seaboard in the same latitude? (P. 25 S.H.)

Ans. Water absorbs heat, stores it, and conveys heat whither it flows. The capacity of air to carry heat is inconsiderable. For this reason the climate near the seaboard is more equable and milder than localities far inland and uninfluenced by the temperature of the sea.

Q. What standard is adopted in the British Isles for estimating the barometrical pressure gradient, and illustrate how it is found? (Pp. 33-35 S.H.)

Ans. The standard of comparison that has been adopted is the difference of pressure expressed in hundreths of an inch in 15 miles of distance.

The maximum gradient for the British Isles is rarely more than ·05 inch.

The distance between the isobars passing through any two places (measured at right angles to the isobars) divided by 15, and the result divided into the difference between the simultaneous barometer readings of the two places will give the gradient.

Example.—The distance between the isobars of A and B, measured at right angles is 120 miles, and the barometer readings are respectively 29·66 and 29·34 inches.

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15)120(8                         29·66
   120                           29·34
   ———                           —————
                                 8)·32
                                 —————
                      Gradient    ·04
                                 —————
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Q. State the months when icebergs are to be found in the North Atlantic and the month when they are at a maximum. (P. 126 S.H.)

Ans. Usually in the spring and summer months. Some years as early as January or February and as late as August.

May is the month when they are usually at a maximum, but it varies, as some years the maximum has been as early as April and in others as late as August.

Q. Describe the track usually taken by cyclones in the North Atlantic, and the seasons when they are most frequent. (P. 75 Bar. Man.)

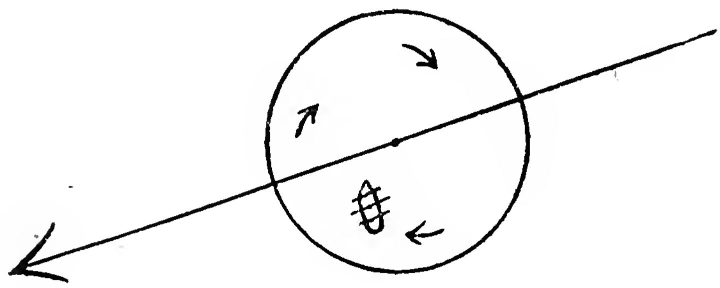
Ans. They begin well to the eastward in about 10° or 12° N and travel about W N W towards the West Indies, recurving in the vicinity of the Bahamas to the Northward and then progress to the N E towards Europe.

Q. By indications you find the ship to be in the left hand semi-circle in the Southern Hemisphere; what changes would you observe in the weather and sea if she ran with the wind on the starboard quarter? (Pp. 74, 77, and 78, Bar. Man.)

Ans. The ship would be running towards the line of progression, and by keeping the wind on the starboard quarter, she would run right into the centre of the cyclone. Wind and sea would increase enormously, barometer would rapidly fall and all conditions would be of the worst possible description.

NOTE.—In answering this question it is essential that candidates should study well and understand pages 67, 68, 74, 77, and 78 of the "Barometer Manual." Most of the papers have similar questions to answer, and by drawing a small diagram similar to Fig. 96 it will assist to answer satisfactorily any of these questions which may have to be solved.

Fig. 96.



It will be necessary to know the following:—

Cyclones in the Northern Hemisphere revolve *left handed* and travel towards the *West and N W* in the tropics, recurving in about *30° N* and thence progressing towards the *N E*. In the Southern Hemisphere they revolve *right handed* and travel the *West and S W* in the tropics, recurving in about *25° S* and thence progressing towards the *S E*.

When it is necessary to heave to, always in either hemisphere heave to on the *port* tack when in the *left* hand semi-circle and on the *starboard* tack when in the *right* hand semi-circle.

When it is necessary to run, always run with the wind on the *starboard* quarter in the Northern Hemisphere and with the wind on the *port* quarter in the Southern Hemisphere.

In the tropics, never run when in the dangerous semi-circle; the *right hand* is the dangerous semi-circle in the Northern Hemisphere and the *left* in the Southern, always heave to.

When in the least dangerous semi-circle heave to or run as occasion requires.

Paper II.

Q. How is temperature affected with height and state the reason? (P. 26 S.H.)

Ans. As a very small proportion of the sun's heat is absorbed by the atmosphere before the rays reach the earth's surface, the upper layers or strata of air receive little or no heat, and the lower layers being in contact with the warm earth acquire by conduction more heat than those at a greater altitude.

Decrease of temperature with height is also caused another way. The upper air is subjected to less pressure than the lower, and when expanding under pressure, the heat required to cause the expansion becomes latent or hidden.

A fall in temperature suddenly ceases at a height of about 6 miles, and in equatorial regions a fall in temperature has been known to continue to a height of 9 miles.

Q. Describe cirro-stratus clouds. (P. 39 S.H.)

Ans. A combination of cirrus and stratus, mostly horizontal or slightly inclined masses of cloud dense in the middle and thin towards the edge, presenting more or less distinctly a formation like a tangled web.

This sheet of cloud often produces halos around the sun or moon.

Q. In what manner does the atmospheric pressure affect the progress of icebergs on the west coast of Greenland? (P. 124 S.H.)

Ans. The centres of most cyclonic depressions in this region pass to the south of Greenland; consequently over Greenland, Davis Strait, and Baffin Bay, easterly and north easterly winds prevail, driving the bergs on the west coast into the open strait and bay.

High pressure over Canada during the spring and often at other times give northerly winds in this bay and strait; in fact the prevailing wind is something near north, from the aforementioned areas of high and low pressure, and together with the current which sets south, the bergs are driven to the southward into the

Atlantic, assisted by the westerly gales when off the Labrador coast.

Q. Where is the atmosphere densest and what effect (if any) has height upon it? (P. 19 S.H.)

Ans. The atmosphere is densest at the earth's surface and diminishes upwards. Seven miles above the earth the density is only $\frac{1}{4}$ of that at the surface, at 14 miles $\frac{1}{16}$th, and at 21 miles $\frac{1}{64}$th.

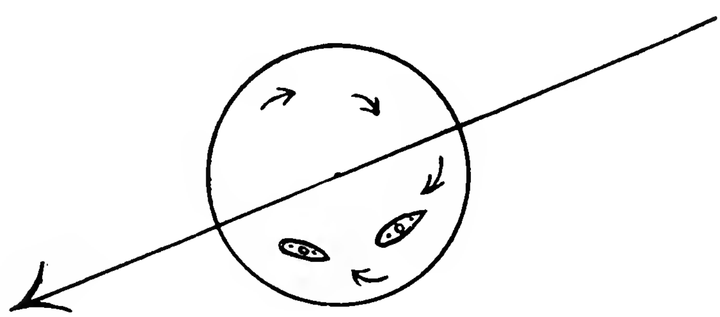
Q. Describe the track usually taken by cyclones in the China Sea, and give the seasons. (P. 76 Bar. Man.)

Ans. They mostly travel to the West and N W. Some recurve to the North and N E, and others continue on and pass over the mainland.

Q. By indications we find the ship in the left hand semi-circle in the Southern Hemisphere; what changes would you observe in the weather and sea, if she was steaming slowly head to sea? (Pp. 74, 77, and 78 Bar. Man.)

Ans. The barometer will fall, wind and sea increase in force and changing to the Eastward until the trough has passed. The barometer will then begin to rise with the wind hauling more Northerly and moderating with the sea. I would keep the ship steaming slowly head on, until the depression had passed.

Fig. 97.



Paper III.

Q. What influence has the earth's rotation on air currents moving from a position of high pressure to a position of relatively low pressure? (Pp. 21, 31, and 32 S.H.)

Ans. The velocity of the earth's rotation is greatest at the equator and decreases as the latitude increases. Air therefore flowing from low to high latitudes and from high to low latitudes, will be deflected to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

For this reason air currents cannot flow direct towards the centres of areas of low barometric pressure, they are deflected, and for this reason cyclones in the Northern Hemisphere revolve left handed or against the hands of a watch, and in the Southern Hemisphere they revolve right handed. Similarly when air from high pressure set outwards to relatively low pressure surrounding it, it will be deflected, and for this reason anticyclones in the Northern Hemisphere revolve right handed and in the Southern Hemisphere they circulate left handed.

Q. When water is being converted into vapour through the process of evaporation, what becomes of the heat and what effect has it? (Pp. 29 and 30 S.H.)

Ans. When a liquid is converted into vapour a large portion of its heat is absorbed in the air and becomes latent or hidden. This heat is not lost because it is again liberated when the vapour is converted into the liquid state. Thus the temperature is increased when vapour is converted into water and decreased when water is converted into vapour.

Q. Describe the formation of strato-cumulus clouds. (P. 40 S.H.)

Ans. Large globular masses or rolls of dark clouds presenting the appearance of grey layers irregularly broken, with blue sky seen through the spaces. The centre of these clouds are of dark colour but not usually associated with rain.

Q. What sort of weather do you expect in the region between the N E and S E trades, and state the cause? (P. 72 S.H.)

Ans. Between the N E and S E trades is a belt of calms and variable winds called the "doldrums." The air in this belt is heated by the vertical rays of the sun and the colder air from the trade winds mixing with the warm disturbs the conditions of the atmosphere, the result being heavy rains, squalls, and variable winds.

Q. What sequence of weather would you expect in the southern half of a cyclone passing over the British Isles? (P. 81 S.H.)

Ans. On the approach of a cyclone the thermometer will likely rise and the hygrometer will show the air becoming more humid. The wind will either veer or back to the South or S W and the barometer begin to fall; the sky will become overcast and rain begin to fall; the wind will increase in violence as the barometer keeps falling and the trough approaches. When the barometer begins to rise the thermometer will likely fall and the air become drier, the rain will have ceased and the wind hauled to the West. As the pressure increases the wind will likely fall and finish from the N W.

Q. An observer finds himself in the southern part of a cyclone in the Northern Hemisphere, what is his position in relation to the centre and the line of progression? (Pp. 74, 77, and 78 Bar. Man.)

Ans. If the observer is in a lower latitude than 25° N, he will be in the left hand semi-circle with the centre to the north of him. If he is in a higher latitude he will be in the right hand semi-circle with the centre to the north of him.

Paper IV.

Q. What is "dry air" and what is the weight of a cubic foot of air at sea level? (Pp. 19, 20, and 28 S.H.)

Ans. Dry air is a mixture of nitrogen, oxygen, argon, and carbonic acid gases.

Nitrogen and oxygen, the chief components of the atmosphere, are always dry and constant and never change their gaseous state. Between the molecules of these two gases is always floating minute particles of water, or aqueous vapour as it is usually termed, and the higher the temperature the more moisture dry air is capable of holding in suspension.

A cubic foot of air at sea level weighs about 500 grains.

Q. State the meaning of the expression "latent heat." (Pp. 29 and 30 S.H.)

Ans. The heat expended in changing the state of a body into some other form is termed "latent heat." In the case of converting water into vapour, the heat is absorbed and cannot be detected by the aid of a thermometer, it is hidden (Latin: *latere* to lie hid) and will reappear when vapour is restored to its liquid state. See Paper III, Question 2.

Q. What is the meaning of "pressure gradient" and show how to find it. (P. 33 S.H.)

Ans. Pressure gradient is the difference of pressure expressed in hundredths of an inch, between any two places. The gradients may be steep or shallow according to the isobaric lines on weather charts being close together or wide apart. The gradients are always steep with gales and hurricanes and shallow when winds are light.

(See Question 3, Paper I, for remainder of answer.)

Q. How much is an iceberg immersed and give your reason for it floating. (P. 123 S.H.)

Ans. A cubic foot of sea water weighs about 64 lbs and a cubic foot of ice about 57 lbs. Ice is therefore *one-ninth* lighter than sea water, and it should (if homogenous) float with *one-ninth* of its bulk above water.

Icebergs are never homogeneous or solid throughout as they enclose bubbles of air and earthy matter; for this reason the bulk of an iceberg above water will likely be one-eighth of its whole height from base to summit.

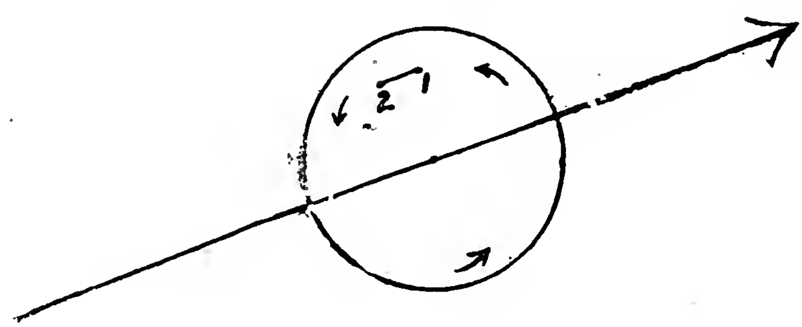
Q. What are the most favourable geographical conditions for the formation of revolving storms? (P. 73 Bar Man.)

Ans. The most favourable conditions are when the coastlines of large continents with numerous bays runs North and South with a large expanse of sea or ocean to the Eastward. These conditions are more or less fulfilled in the North Atlantic (including the West Indies), North Pacific, China Sea, Bay of Bengal, Arabian Sea, and South Indian Ocean.

Q. Your ship is hove to heading North in the Northern Hemisphere on the starboard tack; there are indications that you are in a cyclone and the wind has shifted to the N E; state what you would do and why. (Pp. 74, 77, and 78 Bar. Man.)

Ans. The wind has shifted from E N E to N E (left handed), the ship is therefore in the left hand semi-circle, and I will either heave to on the port tack (coming up tack) or run with the wind on the starboard quarter until the barometer began to rise and the wind and sea have moderated.

Fig. 98.



Paper V.

Q. Broadly speaking, in what directions do the interchanges of air take (*a*) with regard to high pressure surrounded by relatively low, and (*b*) from a low pressure area surrounded by high? (P. 22 S.H.)

Ans. The velocity of the earth's rotation is greatest at the equator and decreases as the latitude increases. For this reason, air flowing from low to high latitudes will be deflected to the right in the Northern Hemisphere and to the left in the Southern Hemisphere; the same applies from high to low latitudes. Anti-cyclones therefore with their areas of high pressure in the centre and the wind flowing outwards will circulate round their centres, right handed in the Northern Hemisphere and left handed or against the hands of a watch in the Southern Hemisphere.

Similarly from an area of low pressure surrounded by high, cyclones with their areas of low pressure in the centre and the wind flowing inwards, will circulate round their centres, left handed in the Northern Hemisphere and right handed in the Southern Hemisphere. (See Paper III., Question 1.)

Q. Describe the cumulus cloud. (P. 40 S.H.)

Ans. A thick cloud with a horizontal base and the upper part dome shaped with protuberances similar to a cauliflower. These clouds are mostly seen during the day and in fine weather usually disappear at night.

They may be dark or bright with shadows, according to their position from the observer and sun.

Q. What is meant by the terms "dry air," "saturated air," and "relative humidity"? (P. 30 S.H.)

Ans. Dry air is all the component parts of the atmosphere with the exception of aqueous vapour.

Saturated air is atmosphere containing the largest possible amount of vapour.

Relative humidity is the percentage of moisture in the air referred to a scale from 0 to 100, where 0 represents perfectly dry air and 100 complete saturation.

Q. How would you utilise the wet and dry bulb thermometer on the approach of an area of low pressure, the wind not having backed or the barometer fallen? (P. 81 S.H.)

Ans. On the approach of an area of low pressure, before the barometer begins to fall or the wind to back or veer, the temperature usually rises and the air becomes more humid, as evinced by the decreasing difference between the wet and dry bulb thermometer.

Q. Describe the construction of the aneroid barometer and state what corrections it requires. (P. 147 S.H.)

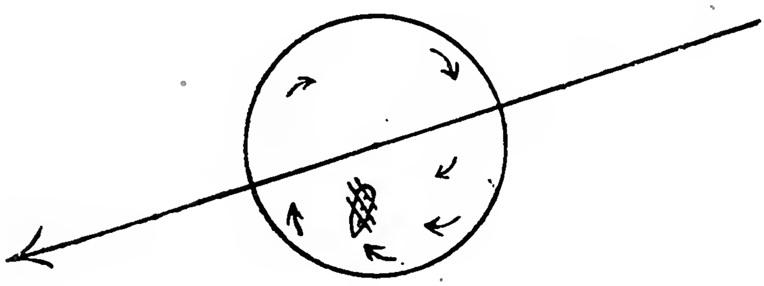
Ans. An aneroid barometer consists of a circular metallic chamber partially exhausted of air and hermitically sealed. The metal is corrugated and therefore elastic, and by an arrangement of delicate levers and springs, a pointer is worked which shows on the dial the pressure of the air. The only corrections necessary are index error and for height above sea level. The index error can be adjusted by a screw at the back of the instrument.

Q. You are in the Southern Hemisphere and there are indications that a cyclone is approaching; the wind has shifted from South to S E. State which semicircle you are in and what action you will take. (P. 74, 77, and 78 Bar. Man.)

Ans. The ship is in the left hand and dangerous semi-circle, I would therefore heave to on the port tack.

As the storm passes over the wind will change towards the East, and after the trough has passed the wind and sea would begin to moderate. I would keep the ship hove to on the port tack until the wind hauled to the N E, and the ship well in the rear of the storm; the latter would be indicated by the rising of the barometer.

Fig. 99.



Paper VI.

Q. What is an "ice blink" and what does it indicate? (P. 120 S.H.)

Ans. An ice blink is a reflection from ice which is seen in the sky near the horizon and indicates the presence of ice in the direction where the reflection is seen. It also renders a snow covered iceberg more distinguishable.

Q. What is "aqueous vapour"; when is it greatest in quantity and when least? (Pp. 20, 28 to 30 S.H.)

Ans. Aqueous vapour is minute particles of water floating between the molecules of dry air, usually in the form of invisible vapour which has risen into the atmosphere by the means of evaporation from water, ice, and snow.

When air contains the largest possible quantity of vapour it can sustain, it is then said to be "saturated," and the higher the temperature the more it can contain; conversely the lower the temperature the less it will contain; this is the reason why there is more moisture in the air in summer than in winter.

For a rise of 29° Fahr. the capacity of dry air to sustain water vapour is doubled, consequently with the highest of temperatures the humidity is greatest and least when the temperatures are low.

Q. Over what area do revolving storms extend and what speed do they travel? (P. 114 S.H. and 75-77 Bar. Man.)

Ans. The areas of cyclones vary in diameter from 20 or 30 miles to many hundreds of miles, and their velocity may be anything up to 45 miles per hour. Some have been known to exceed this speed, and there is a case on record of one travelling 62 miles per hour. Twelve miles an hour is a fair average, but it varies in the different oceans.

Q. What are the indications of the approach of revolving storms, and what are the two principal points necessary to know? (P. 77 Bar. Man.)

Ans. Unsteady barometer, cessation of diurnal range, ugly threatening appearance of the weather, increasing number and severity of gusts, and a heavy long swell or a confused sea.

The two necessary points to know are the bearing of the centre of the storm and which semicircle the ship is in. The former is found by Buys-Ballot's law, and the latter by heaving to and noting how the wind changes.

Q. Why is the temperature range over the British Isles less than over large continental countries? (P. 27 S.H.)

Ans. Owing to the influence of the ocean, the British Isles has a very small range of temperature compared with large continents, which are too far away from the sea for the air in the summer to be cooled from the relatively low temperature of the sea, and in the winter to be warmed by the relatively high temperature of the ocean; the range of temperature must therefore be great in the interior of large continents compared with localities situated in the neighbourhood of the sea.

Q. What is a line squall? (P. 73 S.H.)

Ans. In a " V " shaped cyclone there is usually a sudden rise in the barometer accompanied by a sudden increase of wind when the trough passes over any area.

The sudden increase of pressure occurs simultaneously along a continuous line which is represented on weather charts by a " fault " or broken isobaric lines.

This continuous line is called a " line squall," and all along the line violent squalls accompanied by heavy showers of rain, hail or snow occur at the first rise of the barometer which is certain to be sudden.

Paper VII.

Q. How does the temperature in adjacent localities affect the equilibrium of the atmosphere? (Pp. 20 and 21 S.H.)

Ans. Adjacent localities having a difference in temperature will also have a difference in atmospheric pressure, because the warmer air will expand and rise and the colder air contract and descend, thus producing two distinct air currents; an upper current rising and setting outwards from the heated region and a lower current setting inwards towards it.

The velocity of these air currents will depend upon the difference between the high and low pressures.

Q. State concisely the meaning of periodical and non-periodical variations of pressure. (Pp. 50-53 Bar. Man.)

Ans. Changes in pressure which recur at regular or nearly regular intervals are termed periodical. The Diurnal Variation, variations of pressure in the tropics which modify Trade Winds and give rise to Monsoons are periodical.

Irregular changes which cause departures from the regular or average condition of the atmosphere and associated with changes of weather are non-periodical. The extent of these changes are much more frequent in the higher latitudes than near the Equator.

Q. State clearly how clouds are formed. (Pp. 29 and 38 S.H.)

Ans. Clouds are merely fog or mist formed in the higher strata of air. As the warm air changed with aqueous vapour expands, it rises into colder regions and owing to the lowering of the temperature becomes saturated; the vapour then condenses on the dust particles of the air and forms cloud.

Q. State the corrections required for a mercurial barometer, how they are applied or compensated? (Pp. 38 and 39 Bar. Man.)

Ans. All mercurial barometer readings should be reduced to sea level, 32° Fahr. and standard gravity at Lat. 45° N or S.

The correction for height above sea level will always be added because pressure at any height above sea level is less on account of the density of the air decreasing with height.

The correction for temperature with barometers having brass scales will be "add" when the thermometer is less than 28° F. and "subt" when over, because the mercury in the tube is shortened owing to contraction and lengthened owing to expansion; this correction also compensates for the variations of temperature of the brass scale on the instrument, and thus reduces the reading to 32° Fahr.

The corrections for latitude will be "add" when over 45° N or S and "subt" when less, owing to weight at the poles being greater than at the equator, the Earth being a spheroid flattened at the poles.

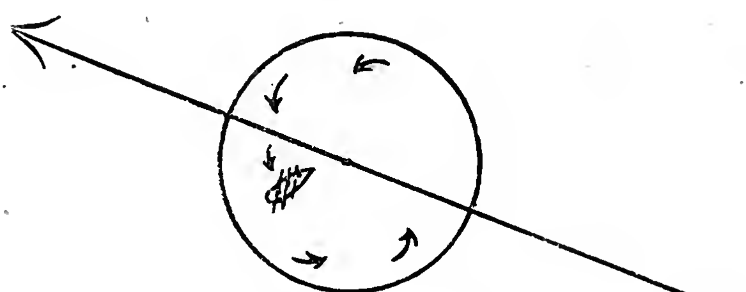
Q. Describe the tracks and seasons of cyclones in the South Pacific. (Pp. 75 and 76 Bar. Man.)

Ans. They begin in about 10° or 12° S and travel about W S W, recurving in about 25° S and then progress towards the S E. Seasons, December to March.

Q. Your ship is in the direct path of a West Indian hurricane with no room to run; state what action you would take and why. (Pp. 74, 77, and 78 Bar. Man.)

Ans. Having no room to run, the ship will have to be hove to, and as she will certainly drift into the left hand semi-circle I will heave to on the port tack (coming up tack) with just sufficient sail to keep her hove to and endeavour to weather the storm until the wind changes sufficient to allow me to run with the wind on the starboard quarter.

Fig. 100.



Paper VIII.

Q. State how high the atmosphere extends above the earth's surface and the method adopted in finding it. (P. 19 S.H.)

Ans. The actual height is not yet known, and beyond a height of 45 miles it is extremely rare, but meteors have been seen 100 miles and more above the earth, which is proof there must be air, as these shooting stars could not become luminous without the friction caused by their rapid passage through the air. Some authorities even claim that in an extremely attenuated form it reaches an altitude of 500 miles.

Q. What is a "V" shaped depression? (P. 71 S.H.)

Ans. This depression is one of a secondary type; and is usually developed in the area termed a "col" which is a lane of relatively low pressure between two areas of high pressure. The southern part of the cyclonic depression extends outwards, and the isobars illustrating it on weather charts forms a "V," hence its name.

Q. Describe the formation of cloud. (P. 29.)

Ans. See Question 3, Paper VII.

Q. Describe terrestrial radiation and its effect the temperature of the earth's surface. (Pp. 25 and 26 S.H.)

Ans. Terrestrial radiation is the reflection of the heat received from the sun thrown back from the earth's surface into space.

By day the earth parts with less heat than it receives from the sun, but at night and especially when the sky is cloudless, the heat is poured into the atmosphere, thus reducing the earth's temperature and the lower strata of air immediately in contact with it.

Q. You are in the left hand semi-circle of a cyclone in the Northern Hemisphere, state what action you would take and why. (P. 78 Bar. Man.)

Ans. This is the least dangerous or navigable semi-circle. I would run with the wind on the starboard quarter until the barometer began to rise and the weather moderated; I should then either heave to on the port tack (coming up tack) or shape a course in the direction I wanted to go.

Q. Describe where cyclones in the South Indian Ocean originate and the tracks taken, also the seasons expected. (Pp. 73 and 75 Bar. Man.))

Ans. They usually begin well to the eastward in about 10° or 12° S and travel about W S W, recurving mostly (it varies much) in about 25° S, and then travel towards the S E. Seasons, November to May.

Paper IX.

Q. How is evaporation influenced by the variations in temperature of the air, also by wind? (P. 29 S.H.)

Ans. The rapidity of evaporation varies with temperature, and the higher the temperature of the air the more vapour it can sustain, therefore warm air is much more moist than cold air, and in the summer the atmosphere contains more vapour than in winter.

Stagnant air over a moist surface speedily becomes saturated when there is no wind, but when dispersed by a breeze evaporation is accelerated.

Q. What is a "glacier" and what becomes of it in the temperate and tropical zones? (P. 117 S.H.)

Ans. A glacier is a river of ice formed from an accumulation of snow which is compacted into ice by the weight of snow and also owing to melting snow freezing at night.

This river is urged downwards at a very slow rate (a few feet a day) from pressure in the rear also by gravitation

In the temperate and tropical zones they only exist at great altitudes, and near the equator they do not form below a height 16,000 feet. In these zones they melt below the snowline and form the sources of rivers.

Q. Describe the formation of the "nimbus cloud." (P. 40 S.H.)

Ans. A thick layer of dark cloud without shape and with ragged edges from which steady rain or snow usually falls; for this reason it is known as the rain cloud.

Small loose clouds floating beneath a large nimbus are called "scud" or fracto-nimbus.

Q. What causes the difference of barometrical pressure between two adjacent localities? (P. 21 S.H.)

Ans. The difference of barometrical pressure between two adjacent localities is caused by the difference in temperature of the same localities.

Difference in temperature between adjacent localities is constantly occurring from a variety of causes: Distribution of land and sea, difference of latitude, greater or less abundance of cloud or rain, or quantity of vapour in the air.

The heated air expands and becomes lighter as it rises; the equilibrium at the surface is therefore destroyed and the cold air of greater pressure flows in below and displaces the lighter or warmer air.

Q. What will you do if a cyclone is approaching when you are in harbour? (Notices to Mariners, old editions.)

Ans. I should be very careful in watching the shifting of the wind and ascertaining the direction of the centre of the cyclone, as by so doing I shall be able to ascertain whether I am in the right or left hand semi-circle, and be able to act according to circumstances.

Q. Describe the tracks and seasons of cyclones in the China Sea. (Pp. 76 Bar. Man.)

Ans. See Paper II., Question 5.

Paper X.

Q. What is the weight of a cubic foot of air at sea level and does it vary? (P. 20 S.H.)

Ans. A cubic foot of air in ordinary circumstances at sea level weighs more than 500 grains. It varies with pressure and temperature, being heavier when the pressure is high and temperature low, and lighter when the temperature is high and pressure low.

Q. State whence the atmosphere derives its moisture. (P. 28 S.H.)

Ans. The atmosphere derives its moisture from water and other moist surfaces including snow and ice; for by evaporation vapour is continually rising into the air, and the drier the air also the higher the temperature, the more evaporation is accelerated. The vapour in the air is usually invisible because of its transparency, but when it is condensed it becomes visible and is seen as mist, fog or cloud.

Q. Describe "alto-cumulus" cloud. (P. 40 S.H.)

Ans. Alto-cumulus is far-off cumulus in largish globular masses, white or greyish, partially shaded, arranged in groups or lines with blue sky visible between the masses. At the margin they form into finer flakes, resembling cirro-cumulus.

Q. What indications has an observer of an approaching depression before the barometer begins to fall, and what would your position be with reference to the line of progression? (P. 77 Bar. Man.)

Ans. Unsteady barometer, cessation of diurnal range, ugly threatening appearance of the weather, dampness of the air, indicated by the hygrometer; increasing number and severity of gusts with rising wind, long heavy swell or confused sea and every appearance by the sky of an approaching storm.

I would stop the ship or heave to on the starboard tack in the Northern Hemisphere and the port tack in the Southern Hemisphere, assuming the ship to be in the dangerous semi-circle; then watch for a change of wind.

If the wind changes to the right I am in the right hand semi-circle, if it changes to the left I will be in the left hand semi-circle, and if the wind increases with no change in direction I will be on the line of progression.

Q. Describe fully the track taken by cyclones in the North Atlantic and where they originate, and the seasons in which they are most frequent. (P. 75 Bar. Man.)

Ans. See Question 5, Paper I.

Q. You are hove to in the Northern Hemisphere and the wind changes left handed. What would you do, and state your reason. (Pp. 77 and 78 Bar. Man.)

Ans. The ship is in the left hand or navigable semi-circle. I would run with the wind on the starboard quarter until the barometer began to rise and the ship well clear of the centre of the storm. When the wind and sea were favourable I could then shape a course or heave to on the port or coming up tack as deemed necessary.

Paper XI.

Q. Give a general description of "Buys Ballot's law." (P. 23 S.H.)

Ans. In the Northern Hemisphere stand with your face to the wind and the barometer will be lower on your right hand than on your left.

In the Southern Hemisphere, facing the wind, the barometer will be lower on your left hand than on the right.

Q. What is the wind's direction in relation to the isobaric lines on a meteorological chart? (P. 32 S.H.)

Ans. The direction of the wind on meteorological charts tends to follow the course of the isobars, but inclines somewhat towards an area of relatively lower pressure.

The angle between the direction of the wind and the isobars is roughly 30°, but no definite rule can be given.

Q. Name the various cloud forms as adopted in the classification of the International Committee and the contractions used when recorded. (Pp. 39 and 40 S.H.)

Ans. Cirrus (Ci), Cirro-Stratus (Ci-St), Cirro-Cumulus (Ci-Cu), Alto-Stratus (A. St), Alto-Cumulus (A. Cu), Strato-Cumulus (St-Cu), Nimbus (Nb), Cumulus (Cu), Cumulo-Nimbus (Cu-Nb), Stratus (St).

Q. At what time in tropical regions is the mean barometrical pressure expected, and what is the average range? (P. 51 Bar. Man.)

Ans. The mean pressure may be expected about midway between the maxima and minima times, i.e., between midnight and 1 a.m., 6 a.m. and 7 a.m., noon and 1 p.m., and about 7 p.m. (See Question 2, Paper xv.)

Q. Describe the tracks and seasons of cyclones in the Arabian Sea. (P. 77 Bar. Man.)

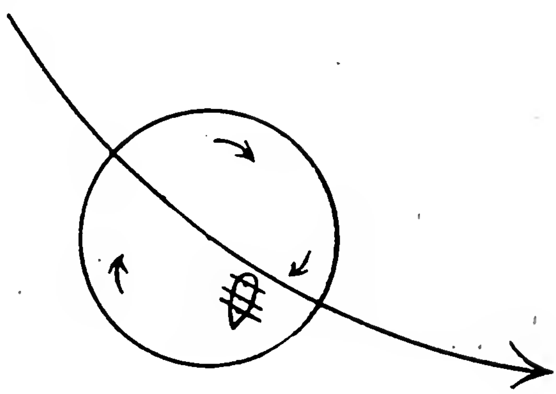
Ans. Storms of the Arabian Sea are of two classes: those which have their origin over the sea and those which reach the sea from the Bay of Bengal. They travel towards the West and N W right across the sea with the exception of some that recurve and go to the N E. Seasons, April, May, June, and again in October and November.

For answer to China Seas, see Question 5, Paper II.

Q. Wind north easterly in the Indian Ocean, barometer falling, wind and sea getting worse, what course of action would you take? (Pp. 74, 77, and 78 Bar. Man.))

Ans. As the barometer is falling and the wind and sea getting worse, the cyclone must have recurved and in all probability the ship is in the direct path of the storm. I should run with the wind on the port quarter until the barometer began to rise and the wind and sea moderated. The ship would then be in the right hand or navigable semi-circle and I would either shape a course or heave to on the starboard tack.

Fig 101.



Paper XII.

Q. What is wind and how is its energy caused? (Pp. 20 and 32 S.H.)

Ans. Wind is air in motion caused by the unequal barometrical pressure between two adjacent places.

The wind blows from where the pressure is greatest, and the greater the difference between the pressures the stronger the wind; in other words, the steeper the barometrical pressure gradients, the stronger the winds.

Q. What is the meaning of the term "vaporisation"? (P. 28 S.H.)

Ans. Vaporisation is the conversion of a liquid into a gaseous state, usually by heating or other artificial means.

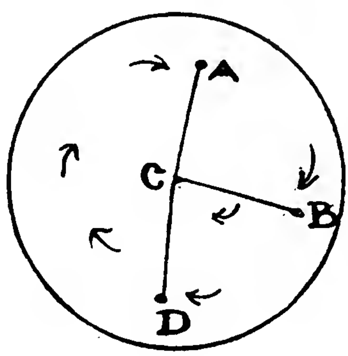
Vaporisation and evaporation are synonymous, the latter expression is generally used when a liquid is slowly and naturally converted into vapour by the temperature and dryness of the air.

Q. Draw a diagram and illustrate the use of Buys-Ballot's law. (P. 23 Bar. Man.)

Ans. From Buys-Ballot's law we are enabled to find approximately the bearing of the centre of a cyclonic depression. In the Northern Hemisphere, face the wind and the barometer will be lower on your right hand than on your left. In the Southern Hemisphere, face the wind and the barometer will be lower on your left hand than on your right.

The diagram is for the Southern Hemisphere, A C, B C, and D C are the directions of the centre from the three positions A, B, and D.

Fig. 102.



The centre may be anything between 8 and 12 points to the right or left of the direction of the wind, according to the hemisphere the ship is in.

Q. Describe in detail the formation of icebergs. (Pp. 117 and 133 S.H.)

Ans. Icebergs are either of glacial or ice barrier origin.

In the Arctic regions (mostly on the west coast of Greenland) glaciers are forced towards the sea by continuous pressure in the rear; they gradually protrude into the sea, a portion breaks away from the parent glacier and gives birth to an iceberg.

In the Antarctic regions some are of glacial origin, but most of the bergs are formed by breaking away from the "great ice barrier." For this reason icebergs in the Southern Hemisphere are mostly flat-topped and wall-sided.

Q. Describe the track of a cyclone in the South Pacific Ocean, where they originate and the months to expect them. (P. 76 Bar. Man.)

Ans. They begin in various longitudes between the latitudes of 10° and 12° S and travel about W S W, recurving in about 25° S and thence progressing to the S E. Seasons, December to April.

For answer to South Indian Ocean, see Paper VIII, Question 6.

Q. By indications we find the ship to be in the left hand semi-circle in the Southern Hemisphere. What changes would we observe if she ran with the wind on the port quarter? (Pp. 74, 77, and 78 Bar. Man.)

Ans. This is the dangerous semi-circle, and if the ship is kept running with the wind on the port quarter she will in all probability run across the path of the storm or perhaps be caught in the vertex.

The course would have to be altered as the wind changed, and it would depend upon the ship's position, speed of the depression, and the speed of the ship, whether she crossed the storm's path or ran right into the centre. As she approached the centre, the barometer would fall, the wind and sea increase with terrific squalls and tempestuous seas, and all indications of weather would be of the worst possible description.

The changes experienced would be different according to the speeds of the storm and ship, but in any case it would be most dangerous and unwise to run with the wind on the port quarter.

Paper XIII.

Q. What is the average pressure at the earth's surface in pounds per square inch, and in which way is the energy directed? (P. 20 S.H.)

Ans. The average pressure of the atmosphere at the earth's surface is *fifteen* pounds on the square inch. This pressure is not only directed downwards but also upwards, sideways, and every possible direction.

Q. What is an "isotherm" and whence does it derive its name? (P. 28 S.H.)

Ans. Isotherm—[Greek, Iso, equal + Therme, heat]. Lines on a chart uniting localities of equal temperature at the same instant.

Q. What is "field ice" and how is it formed? (Pp. 118 and 125 S.H.)

Ans. Field ice is an accumulation of flat ice over areas both large and small. It is usually unnavigable owing to the influence of the wind keeping the parts close and packed. It is formed by the water freezing near the shore, also in gulfs and bays, and in the Arctic regions.

Q. Describe the formation of "alto-stratus" clouds. (P. 40 S.H.)

Ans. A sheet of grey colour well above the horizon varying in shade; it may be light or dark, sometimes thick and at other times thin, through which the sun or moon is dimly seen.

Q. Draw a diagram to illustrate the tracks of revolving storms from the tropics to the temperate zones, also the circulation of the wind in the storm field. (P. 74 Bar. Man.)

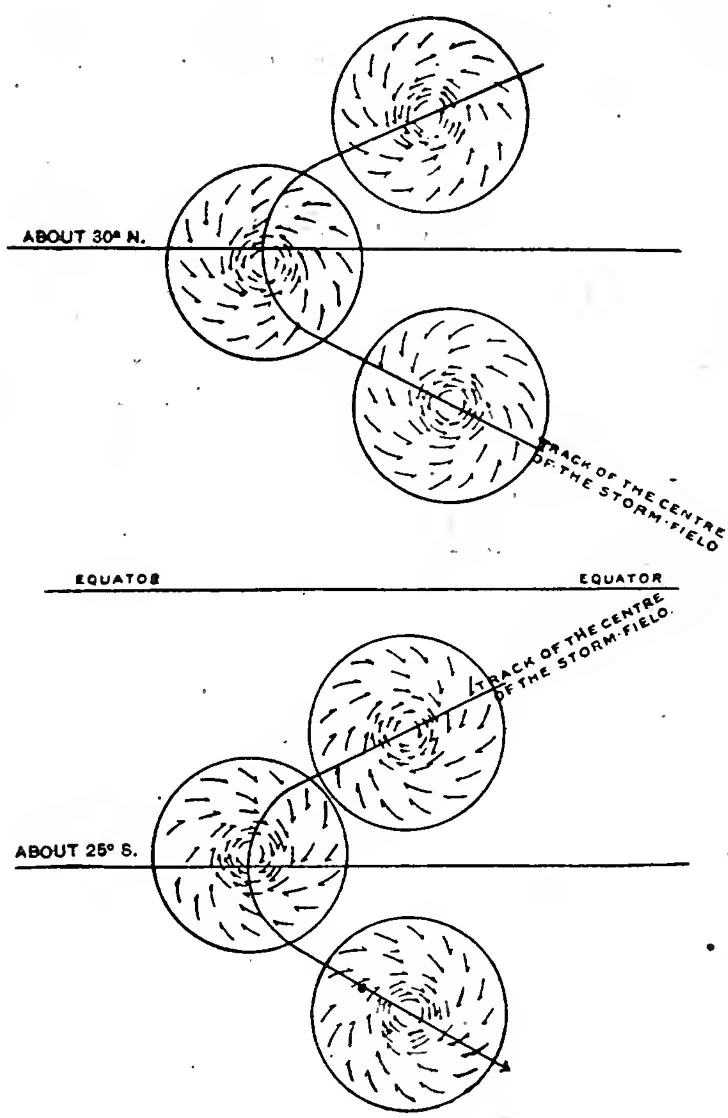


Fig. 103.

Q. You are in the right hand semi-circle in the Southern Hemisphere steaming with the wind on the port beam, what action will you take (if any), and state your reasons for doing so? (Pp. 74, 77, and 78 Bar. Man.)

Ans. The ship is in the navigable semi-circle heading and steaming the fastest way from the centre of the storm. I should keep her going in this direction, because she is going away from the centre with a rising barometer, and in all probability better weather and a more moderate sea.

Paper XIV.

Q. Of what gases is the atmosphere composed, and state the average percentage of each? (P. 19 S.H.)

Ans. The atmosphere is an aerial ocean consisting of dry air and aqueous vapour intimately mixed.

The dry air is mostly composed of Nitrogen and Oxygen gases.

The average percentage of each are:—

Nitrogen	77·11	per cent
Oxygen	20·65	,,
Aqueous Vapour ...	1·40	,,
Argon	0·79	,,
Carbonic Acid	0·04	,,

Q. In what localities will the sun's rays have their greatest effect, and state where the effect will be modified, and give a reason for it? (P. 25 S.H.)

Ans. The sun's rays have their greatest effect when they fall vertically on the earth's surface. This can only occur in the tropics where the effect is at its maximum, and it decreases polewards. In the higher latitudes differences in temperature do not depend upon the difference in latitude, it is modified by the influence of the sea, ocean currents, and winds.

Q. How does the observed velocity of the wind compare with the theoretical velocity obtained from the gradient, and give a reason for the difference? (Pp. 35-37 S.H.)

Ans. The observed wind velocity seldom agrees with the velocity calculated from the gradient.

The gradient velocity is generally in excess of the observed, and it has not yet been possible to calculate velocities to always agree with that observed.

The reasons for this difference are many:— Insufficient data, arrangements and instruments not refined enough, the effect of friction over the sea is not known, nor is the effect of the obstruction by land known.

It has been found that in some parts of the earth, with the same gradient, the wind is stronger than at other parts, and that in summer with the same gradient, the wind is stronger than in winter.

Q. State what is meant by a secondary wind system. (P. 69 S.H.)

Ans. Sometimes the regular sequence of changes in pressure is interrupted by the formation of a subsidiary depression accompanied by rain or snow.

Over the British Isles this depression almost always occurs to the southward of the primary and appears to be thrown off the larger cyclone.

The winds are usually moderate, and sometimes this smaller system assumes such large proportions that it is difficult to tell which of the two is the primary.

Q. Which is the dangerous and which the navigable semi-circle in tropical revolving storms, and state the reason? (P. 75 Bar. Man.)

Ans. The right hand semi-circle is the dangerous and the left the navigable in the Northern Hemisphere. In the Southern Hemisphere the left hand semi-circle is the dangerous and the right the navigable.

In the dangerous semi-circle it is always prudent to heave to on the coming up tack (starboard tack in the right hand semi-circle and port tack in the left hand semi-circle) because the storm will likely pass, and the ship is not likely to break off or be caught aback.

If the ship was put before the wind and allowed to run she would either cross the path of the storm or be caught in the centre; this is the reason why it is called the dangerous semi-circle; then there is the danger of the storm recurving at any moment with its centre over the position of the ship.

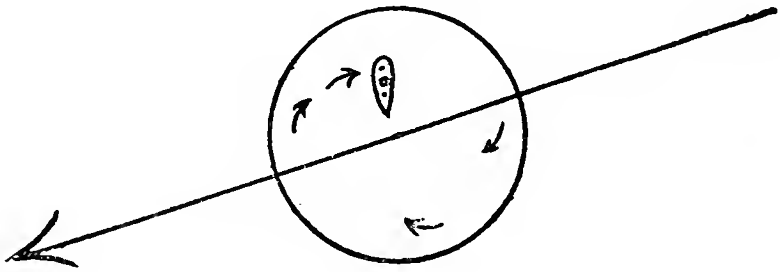
In the navigable semi-circle, the ship may be hove to or allowed to run as circumstances admit without the danger of getting near or into the centre. Run with the wind on the starboard quarter in the Northern Hemisphere and with the wind on the port quarter in the Southern Hemisphere.

Q. Suppose you were steaming with the wind on the starboard beam in the right hand semi-circle of a cyclone in the Southern Hemisphere, what alteration (if any) would you make in your course, and why? (Pp. 74, 77, and 78 Bar. Man.)

Ans. The ship would be steaming right into the centre of the storm. I should therefore turn her round and steam in the opposite direction with the wind on the port beam until the barometer began to rise and the weather moderated sufficient to allow me to resume my original course.

In the event of wind and sea being too high to allow me to steam as above, I should heave her to head on to sea, and keep her so until the wind and sea moderated with a rising barometer.

Fig. 104.



Paper XV.

Q. Describe in detail the formation of Cyclones and Anti-cyclones. (P. 32 S.H.)

Ans. Cyclones are regions of low barometrical pressure surrounded by high. Air currents owing to the action of gravity set from the high towards the low pressure, but by the earth's rotation they are deflected to the right in the Northern Hemisphere and to the left in the Southern, so that, instead of the wind flowing direct towards the centre it will be deflected and circulate round the centre against the hands of a watch (left handed) in the Northern Hemisphere and with the watch hands (right handed) in the Southern Hemisphere.

Anti-cyclones are regions of high barometrical pressure surrounded by low, and air currents instead of flowing directly outwards from the centre will be deflected and circulate round the area of high pressure with the hands of a watch (right handed) in the Northern Hemisphere and against (left handed) in the Southern.

Q. State what is meant by "diurnal range" or variation of pressure in tropical and sub-tropical zones, give the times of maxima and minima, and the regions where the range is greatest and least. (P. 50 Bar. Man.)

Ans. The diurnal range of the barometer consists of a double oscillation, there being two periods of increase and two of decrease during each 24 hours.

The maxima occurs about 10 a.m. and 10 p.m., and the minima about 4 a.m. and 4 p.m. The forenoon maximum is usually greater than the afternoon maximum, and the range is greatest within the tropics, about ·07 or ·08 of an inch; it decreases as the latitude increases, and in sub-tropical seas the range is about ·04 of an inch.

In the Arctic and Antarctic regions it is scarcely perceptible.

Q. What is "dew," and how is it produced? (P. 30 S.H.)

Ans. Dew is moisture in the lower strata of atmosphere which is chilled after sunset, owing to the earth's surface becoming colder than the air in contact with it; it is deposited as small drops without the formation of any visible cloud, and is only abundant during clear and calm nights.

The temperature at which dew is formed is called the "dew point," it varies with the degree of humidity of the atmosphere, and when the dew point is below 32° F. the minute drops are frozen and is known as "hoar frost."

Q. Describe the formation of "sea fog." (P. 49 S.H.)

Ans. The formation of sea fog is due principally to the effect of warm moist air passing over relatively cold water, and sometimes to cold air passing over warm water.

In the former, the warm air is cooled to saturation and the moisture condensed into a cloud. The fog in this case as a rule only rises a few hundred feet above the sea.

In the latter case, the cold air chills the moisture over the sea as the vapour rises, and condenses it into minute particles of water which form cloud or mist. In this case the fog rises to a comparatively high altitude, and near the surface of the sea the fog as a rule is not dense.

Q. Which are the navigable and dangerous semi-circles of a tropical cyclone, and why are they so named? (P. 75 Bar. Man.)

Ans. In a tropical cyclone, one semi-circle is known as the navigable semi-circle and the other as the dangerous.

In the former a ship may be hove to or allowed to run according to circumstances, hence its name; but in the latter, on no account must the ship be allowed to run, she must be hove to until the storm has passed or until the weather has moderated with a rising barometer. The danger in this semi-circle is the likelihood that she will cross the path of the storm or may be caught in the centre, if allowed to run before the wind.

In the Northern Hemisphere, the right hand semi-circle is the dangerous and the left hand the navigable.

In the Southern Hemisphere, the left hand semi-circle is the dangerous and the right hand the navigable.

Q. You are hove to in the Northern Hemisphere, and the wind backs from S W to S; give the bearing of the centre and what action you would take. (Pp. 74, 77, and 78 Bar. Man.)

Ans. The wind has shifted to the left, the ship is therefore in the left hand or navigable semi-circle with the centre bearing something between West and N. W. I would run with the wind on the starboard quarter until the barometer had risen sufficient to ensure that the ship was in a safe position.

Paper XVI.

Q. Describe the meaning and derivation of the word "cyclone." (P. 23 S.H.)

Ans. The term cyclone was originally adopted by Piddington to express the characteristic distribution of pressure and wind around an area of relatively low pressure. The word is derived from the Greek "Kuklos," meaning amongst other things—the coil of a snake, sufficiently expressing the tendency to circulate, and not affirming the circle to be true.

Q. Why is there generally more rain in the polar semi-circle than in the equatorial in a cyclonic depression and give reasons for the same? (P. 56 S.H.)

Ans. Winds that enter the polar side of a cyclonic depression have their origin for the most part in high latitudes and are therefore relatively cold.

These cold currents of air force upwards the warm air, which quickly cools below the point of saturation; and because cold air has not the capacity of warm air for sustaining moisture, the rainfall associated with the polar semi-circle is more copious than the equatorial.

Q. What are the most favourable atmospheric conditions for the formation of "mirage" and describe same? (P. 167 S.H.)

Ans. Mirage is an optical illusion due to refraction or excessive bending of rays of light traversing adjacent layers of air of widely different densities.

When hot air passes over cool air, distant objects are seen too high, and images of objects below the horizon are thus observed.

When cool air passes over warm water, distant objects owing to refraction are inverted and seen too low.

Q. What is the principle of the thermometer and give the different standards of scales on which thermometers are graduated? (P. 151 S.H.)

Ans. A thermometer consists of a closed glass tube with a very fine bore, bulbed at one end and partially filled with mercury or some other fluid, which contracts when cooled, receding towards the bulb, and expands when warmed and rising in the tube.

There are various standards:—Fahrenheit, with a scale of 180° between freezing and boiling points—32°, freezing and 212°, boiling.

Réaumurs is divided into 80° between freezing and boiling—0°, freezing and 80°, boiling.

Centigrade or Celsius—0°, freezing and 100°, boiling.

Absolute—273°, freezing and 373°, boiling. There is no minus reading on the absolute scale as the zero point begins at a temperature where there is absolutely no heat or energy.

Q. Describe the tracks taken by cyclones in the Bay of Bengal and the months most favourable for their formation. (Pp. 76 and 77 Bar. Man.)

Ans. The tracks are mostly between W N W and N W. Some recurve to the N E and others continue their course over the land into the Arabian Sea Seasons, April to December; worst months, May, October, and November.

Q. In the Indian Ocean a trade wind freshening to a gale with falling barometer and threatening appearance of the weather, state how you would act and your reasons for doing so? (P. 78 Bar. Man.)

Ans. I would heave to on the port tack and watch the wind and barometer. If the wind shifts to the East, I would remain hove to on the port tack, because she is in the left hand semi-circle, and the port is the coming up tack. If the wind remains steady at S E or shifts to the South, I would run to the N W across the path of the storm, and heave to on the starboard tack when the wind and sea became favourable.

Paper XVII.

Q. State the seasons as determined by the march of temperate in the temperate zones and give the months of each. Give also the highest and lowest mean daily temperature at Greenwich. (P. 27 S.H.)

Ans. In the temperate zones the seasons group themselves into four periods:—Northern Hemisphere, spring—March, April, May; summer—June, July, August; autumn—September, October, November; winter—December, January, February.

Southern Hemisphere, spring—September, October, November; summer—December, January, February; autumn—March, April, May; winter—June, July, August.

The highest mean daily temperature at Greenwich is 64° F. and occurs on the 15th July; the lowest is 37·5° F., and occurs on the 12th of January.

Q. State the various terms applied to floating ice. (P. 119 S.H.)

Ans. Icebergs, Growlers, Field ice, Floe ice, Land ice, Hummocky ice, Pack ice, Drift ice, Brash or Sludge, Pancake ice, Bay ice, Floeberg, and Slob ice.

Explanation of above:—

Icebergs. Floating masses of ice severed from glaciers or from the great ice barrier.

Field ice. Flat ice extending over a large area and usually unnavigable; it frequently piles and becomes uneven.

Growlers. Fragments of bergs trapped and embedded in field ice.

Floe ice. Pieces of ice frozen or pressed together.

Land ice. Ice attached to the shore.

Hummocky ice. Hummocks of ice, caused by the edges of ice floes being pushed up into the form of pyramids by the force of strong winds.

Pack ice. Broken pieces of ice which have closed together by the force of the wind.

Drift ice. Unattached pieces of ice.

Brash or Sludge. Loose pieces of ice, through which a ship can easily navigate.

Pancake ice. Newly frozen ice separated into pieces in the form of a pancake.

Bay ice. New frozen ice in a bay.

Floeberg. Thick pieces of ice piled and frozen one upon another, and high enough to present the appearance of a small iceberg.

Slob ice. Newly formed ice crushed by wind and sea and piled to a height of 3 to 10 feet.

Q. Name the five great areas the earth's surface is divided into, with regard to barometrical pressure. (P. 48 Bar. Man.)

Ans. The five great areas of pressure are:—A belt of moderately low pressure over the equatorial regions.

North and South of the tropics are belts of high pressure.

North and South of the parallels of 40° are areas of lower pressure; the southern area forms a complete circuit round the globe.

Q. State as clearly as possible the cause of "trade winds." (Pp. 58 and 59 Bar. Man.)

Ans. North and South of the tropics are belts of relatively high pressure, in each of which are situated areas of maximum pressure or anti-cyclones, elliptical in shape.

Round the centres of these maximum pressures there is a circulation, right handed in the Northern Hemisphere and left handed in the Southern Hemisphere.

This circulation is constant in the eastern and equatorial segments in both hemispheres, thus producing permanent winds from the polar and eastern quarters, known as the N E and S E trades.

Q. What are the indications of the approach of revolving storms? (P. 77 Bar. Man.)

Ans. Unsteady barometer, cessation of diurnal range, ugly threatening appearance of the weather, increasing number and severity of gusts with rising wind, heavy long swell from the direction the storm is approaching, and a confused sea.

Q. You have reason to think that your vessel is in the direct path of a storm in the Southern Hemisphere, what course would you pursue? (P. 78 Bar. Man.)

Ans. I would run with the wind on the port quarter until the wind and sea moderated and the barometer began to rise. I could then heave to on the starboard tack (coming up tack), or shape a course according to the direction the ship was bound.

Paper XVIII.

Q. What is rain, and how is it caused? (P. 55 S.H.)

Ans. Rain is water restored to the earth after undergoing the process of evaporation and condensation.

It is produced by the uniting of minute particles of water that form cloud, into rain drops, which fall to the earth through the action of gravity.

Q. What effect has the earth's rotation on a current of air (*a*) moving from a lower to a higher latitude and (*b*) from higher to lower latitude? Give reasons. (Pp. 56 and 57 Bar. Man.)

Ans. The velocity of the earth's rotation at the equator is about 1,000 per hour and gradually diminishes towards the poles, where it is zero.

For this reason, air currents moving in any direction on the earth's surface will be deflected to the right in the Northern Hemisphere and to left in the Southern; therefore a current of air moving (*a*) from a lower to a higher latitude will give rise to a South Westerly wind and (*b*) from high to lower latitude a North Easterly wind.

Q. State clearly the meaning of "relative humidity." (P. 30 S.H.)

Ans. Relative humidity is the percentage of moisture in the air referred to a scale from 0 to 100, where 0 represents perfectly dry air and 100 complete saturation.

Q. Describe a "barograph," state what corrections are required, and how is it regulated. (P. 44 Bar. Man.)

Ans. A barograph is an aneroid barometer consisting of a series of vacuum metal boxes with elastic lids, and is connected with a revolving drum by means of a lever carrying a pen filled with ink. The rotation of the drum is effected by means of clockwork inside the drum, which is designed to complete a revolution in seven days.

Set round this drum is a printed chart, with the days of the week, time, and barometer graduations, and the variations of barometrical pressure is transmitted from the vacuum boxes through the lever to the pen, which traces on the printed chart the height of barometer readings from the beginning until the end of the week.

The barograph should be frequently compared with a mercury barometer and the only corrections necessary are index error and height above sea level.

The timepiece is regulated the same as a watch, by moving the pointer on the balance to fast or slow.

Q. Describe the diurnal range of the barometer in tropical and sub-tropical regions, and what you would expect with its cessation. (P. 50 S.H.)

Ans. The diurnal variation of pressure consists of a double oscillation of the barometer, there being two periods of increase and two of decrease each day; the highest readings are about 10 a.m. and 10 p.m., and the lowest about 4 a.m. and 4 p.m. The mean pressure will be about midway between these times, viz., 1 a.m. and 1 p.m., also about 7 a.m. and 7 p.m.

In the tropics the diurnal variation attains its greatest magnitude, which is approximately ·07 of an inch; in the sub-tropical regions it diminishes, the range being about ·04 of an inch, and in the higher latitudes it is scarcely perceptible and can seldom be recognised.

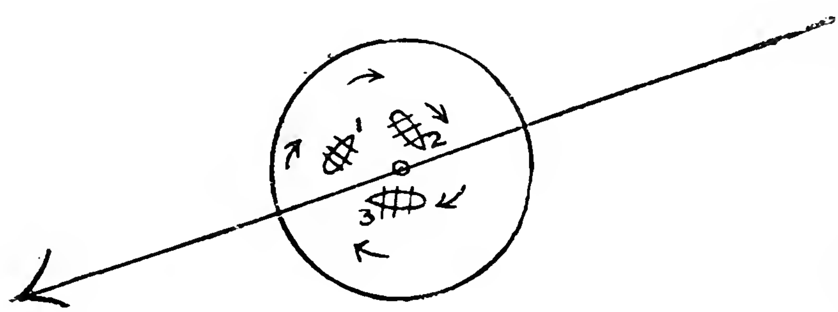
Any marked deviation from this daily range is an indication that some considerable atmospheric disturbance has arisen, and that a change of weather, possibly a hurricane, is impending.

Q. Your ship is in the right hand semi-circle of a Southern Hemisphere cyclone and running with the wind aft; what changes would you expect in wind and weather and state the reason? (P. 74 Bar. Man.)

Ans. The ship is travelling in the opposite direction to the cyclone, and if she is in front of the trough (position 1) the barometer will quickly fall, the wind and sea will increase in violence, the wind also veering to the westward.

If she is kept running with the wind aft, the course will have to be constantly altered, and after the trough has passed (position 2) she will run across the line of progression, in the rear of the storm's centre, into the left hand semi-circle. It will now depend upon the speed of ship and storm what transpires. If the ship is running faster than the storm, she will either run (position 3) across the path of the storm in front of its centre into the right hand semi-circle or be caught in the vortex. If the storm is the faster, the centre will gradually move away from the ship, and the barometer will slowly rise with indications of better weather.

Fig. 105.



Paper XIX.

Q. How is terrestrial radiation accelerated and how retarded? (P. 26 S.H.)

Ans. The heat received by the earth from the sun is poured back into space, and is greatly accelerated when the air is dry and cloudless; but when the air is moist and the sky overcast or cloudy, the loss of heat is not so great because clouds intercept heat and radiate it back, and moist air absorbs heat.

Q. Describe the formation of the "cirrus cloud." (P. 39 S.H.)

Ans. Minute particles of ice, which appear as clouds of delicate or fibrous appearance in the upper atmosphere showing a featherlike structure, usually called "mare's-tails."

Q. What is a "gust" and what is a "squall"? How are they caused? (P. 71 S.H.)

Ans. A gust is a sudden and transient increase in the force of the wind, caused by the mixing of cold and warm air currents.

A squall is a gust of greater intensity and longer duration. Gusts and squalls may occur in calms and light airs, and are also associated with gales and hurricanes.

Q. Describe the principal features of icebergs in the Southern Hemisphere. (P. 129 S.H.)

Ans. Icebergs in the Southern Hemisphere are mostly tabular or flat topped in form, because they originally formed part of the great ice barrier.

Many are of phenomenal heights and size; some have been sighted over 1,000 feet in height and over 50 miles in length.

Q. You are in the right hand semi-circle of a cyclone in the Northern Hemisphere, state what action you would take. (Pp. 74, 77, and 78 Bar. Man.)

Ans. Heave to on the starboard tack (coming up tack). After the trough has passed, the barometer will rise, and the sea and wind moderate. I can then shape my course.

Q. Describe fully the track of a cyclone in the South Pacific; where do they originate, and what months are they frequent? (Pp. 75 and 76 Bar. Man.)

Ans. They begin in about 10° or 12° S, and travel about W S W, recurving in about 25° S, and thence progressing towards the S E. Seasons, December to March.

Paper XX.

Q. What is "aqueous vapour" and how produced? (P. 28 S.H.)

Ans. Aqueous vapour is moisture suspended between the molecules of dry air and consisting of minute particles of water which have risen into the atmosphere from the earth's surface in the form of vapour.

Q. Describe the mercurial barometer and its principle. (P. 136 S.H.)

Ans. The principle of a mercurial barometer is that the column of mercury in the tube is balanced by the pressure of the atmosphere.

A mercurial barometer consists of a glass tube about 33 inches in length with its lower end immersed in a cistern of mercury. The pressure of the atmosphere acts on the surface of the mercury in the cistern and balances a column of mercury in the tube. The average pressure is about 30 inches, and as the tube is about 33 inches in length, a vacuum (Torricellian vacuum) of about 3 inches is at the top of the tube. When the atmospheric pressure increases the column of mercury in the tube rises, and when it decreases the column of mercury falls.

There are two scales at the top of the mercury on barometers lent by the Meteorological Office; the right hand scale is graduated to inches and twentieths of an inch, the left hand is graduated in centibars and millibars. Each scale has a vernier for finer readings.

Q. What is the range of temperature in the British Isles? (P. 27 S.H.)

Ans. The range shown by a thermometer shaded in open air is about 70° F., from 10° in winter to 80° in the summer. In the hardest winters the thermometer reads much lower than 10° and in the hottest summers higher than 80°.

Q. Describe "cirro-cumulus" cloud. (P. 39 S.H.)

Ans. Small globular masses or white flakes without shadows, or showing very slight shadows, arranged in groups and often in lines. (Mackerel Sky.)

Q. You have reason to believe you are on the line of progression of a cyclone in the Southern Hemisphere, what action would you take? (Pp. 74, 77, and 78 Bar. Man.)

Ans. Run with the wind on the port quarter into the right hand or navigable semi-circle.

When the barometer had risen sufficient and the wind, sea, and weather favourable, I could then either heave to on the starboard tack (coming up tack) or set my course.

Q. Describe the track usually taken by cyclones in the China Sea, and give the seasons. (P. 76 Bar. Man.)

Ans. They mostly travel to the West and N W. Some recurve to the North and N E, and others continue on and pass over the mainland. Seasons, most frequent between July and October.

MERCHANT SHIPPING.

Prevention of Accidents:—Life-Saving Appliances.

FOREIGN-GOING.

Rules for Foreign-going Passenger Steamers, including Emigrant ships.

Rule A.—A ship of this class shall carry lifeboats in such number and of such capacity as shall be sufficient to accommodate the total number of persons which is carried, or which the ship is certified to carry, whichever number is the greater.

Rules for Foreign-going Steamships not certified to carry Passengers.

Rule A.—A ship of this class shall carry on each side of the ship lifeboats of Class 1 in such number and of such capacity as will accommodate all persons on board; Provided that if the total number of lifeboats required under this Rule exceeds two, a boat of Class 3 may be carried in lieu of one of them; and if the number exceeds three, one or two boats of Class 3 may be carried in lieu of the same number of lifeboats. All the boats shall be equipped as provided in the General Rules.

Rule B.—The lifeboats shall be attached to davits, or other approved appliances at least as effective as davits shall be provided in lieu of davits.

Rule C.—At least six approved lifebuoys shall be carried, together with one approved life-jacket for each person on board.

Rules for Foreign-going Sailing Ships not carrying Passengers.

Rule A.—A ship of this class shall carry lifeboats of Class 1 in such number and of such capacity as shall be sufficient to accommodate all persons on board; Provided that if the number of lifeboats required under this Rule exceeds two a boat of Class 3 may be carried in lieu of one of them. All the boats shall be equipped as provided in the General Rules.

Rule B.—Two boats at least shall be attached to davits, or other approved appliances at least as effective as davits shall be provided in lieu of davits.

Rule C.—At least four approved lifebuoys shall be carried, together with one approved life-jacket for each person on board.

Rules for Steamships trading within Home Trade limits, but not certified to carry Passengers.

Rule A.—A ship of this class having a length of 100 feet or over shall carry a boat or boats on each side of the ship of such capacity as shall be sufficient to accommodate all persons on board. Such boats shall be attached to davits, or other approved appliances at least as effective as davits shall be provided in lieu of davits.

Rule B.—One of such boats may be a boat of Class 3. The remaining boats shall be lifeboats of Class 1; and all the boats shall be equipped as provided in the General Rules.

Rule C.—A ship of this class having a length under 100 feet shall carry at least one boat of Class 1, so stowed that it can be readily placed in the water on either side of the ship, and of sufficient capacity to accommodate all persons on board. The method of stowage and the means of putting the boat overboard shall be to the satisfaction of the Board of Trade.

The boat shall be equipped as provided in the General Rules.

Rule D.—A ship of this class if 100 feet in length or over shall carry at least four approved lifebuoys, and if under 100 feet at least two approved lifebuoys. One approved life-jacket shall be carried for each person on board.

Rules for Sailing Ships trading within Home Trade limits but not carrying Passengers.

Rule A.—Subject to the provisions of Rule B, a ship of this class shall carry a boat or boats of such capacity as shall be sufficient to accommodate all persons on board. The boats shall be stowed in such a manner that they can readily be placed in the water on either side of the ship to the satisfaction of the Board of Trade. At least one of the boats shall be a boat of Class 1, fitted with internal buoyancy; and all the boats shall be equipped as provided in the General Rules.

Rule B.—A ship of this class having a length of under 100 feet and engaged solely in the Coasting Trade shall comply with the requirements of Rule A, except that the boat or boats carried may be of Class 3 without internal buoyancy.

Rule C.—A ship of this class if 100 feet in length or over shall carry at least four approved lifebuoys, and if under 100 feet at least two approved lifebuoys. One approved life-jacket shall be carried for each person on board.

GENERAL RULES.

1. Boats.

(1) All boats shall be properly constructed and equipped as provided by these Rules, and shall be of such form and proportions that they shall have sufficient freeboard, and ample stability in a seaway, when loaded with their full complement of persons and equipment.

(2) All boats shall be marked in such a way as to indicate plainly their dimensions and the number of persons for which they are approved.

(3) The structural strength of the boats shall be to the satisfaction of the Board of Trade, and in all cases in which a boat would have to be lowered with its full complement on board to comply with General Rule 5 (2), the strength shall be sufficient for that purpose.

In all open boats, all thwart and side seats must be fitted as low in the boat as practicable, and must provide seating accommodation for all persons the boat is deemed fit to carry, and bottom boards must be fitted so that the thwarts shall not be more than 2 feet 9 inches above them.

All boats and other life-saving appliances shall be kept fit and ready for use, and fitted and arranged to the satisfaction of the Board of Trade. Internal buoyancy apparatus shall be constructed of copper or yellow metal of not less than 18 ozs. to the superficial foot, or of other durable material.

(4) Save as expressly provided in these Rules to the contrary, the lifeboats carried on any vessel may be either open lifeboats of Section A or Section B, or decked lifeboats of Section C.

Class 1.

A. Open lifeboats with internal buoyancy only.

The buoyancy of a wooden boat of this type shall be provided by water-tight air-cases, the total volume of which shall be at least equal to one-tenth of the cubic capacity of the boat.

In the case of a metal boat an addition shall be made to the cubic capacity of the air-tight compartments, so as to give it buoyancy equal to that of the wooden boat.

B. Open lifeboats with internal and external buoyancy.

The internal buoyancy of a wooden boat of this type shall be provided by water-tight air-cases, the total volume of which shall be at least equal to seven and a half per cent of the cubic capacity of the boat.

If the external buoyancy is of cork, its volume, for a wooden boat, shall not be less than thirty-three thousandths of the cubic capacity of the boat; if of any material other than cork, its volume and distribution shall be such that the buoyancy and stability of the boat are not less than that of a similar boat provided with external buoyancy of cork.

In the case of a metal boat an addition shall be made to the cubic capacity of the air-tight compartments, so as to give it buoyancy equal to that of the wooden boat.

C. Pontoon lifeboats having a well deck and fixed water-tight bulwarks.

The area of the well deck of a boat of this type shall be at least thirty per cent of the total deck area. The height of the well deck above the water line at all points shall be at least equal to one-half per cent of the length of the boat, and one and a half per cent at the ends.

Class 3.

Open boats which have not the buoyancy required for lifeboats of Class 1.

Motor Boats.

(1) An approved motor boat may be carried as a lifeboat subject to the following conditions:—

(*a*) It shall comply with the requirements for a lifeboat of Class 1, and proper appliances shall be provided for putting it into the water speedily.

(*b*) It shall be adequately provided with fuel, and kept so as to be at all times fit and ready for use.

(2) Where the number of lifeboats is less than ten, one of them may be a motor boat. Where the number of lifeboats is not less than ten, two of them may be motor boats. The Board of Trade may, on the application of an owner, allow a greater number of motor boats to be carried, if they are satisfied that the efficiency of the life-saving equipment will not thereby be diminished.

2. Cubic Capacity.

The cubic capacity of an open boat shall be ascertained by multiplying the product of the length, breadth, and depth by ·6.

The length and breadth are measured outside and the depth inside.

A boat 28 feet long, 8 feet 6 inches broad, and 3 feet 6 inches deep, will be regarded as having a capacity of $28 \times 8{\cdot}5 \times 3{\cdot}5 \times {\cdot}6 = 499{\cdot}8$, or 500 cubic feet.

The cubic capacity of a decked lifeboat shall be deemed to be the number of cubic feet obtained by multiplying by 10 the number of persons the boat is deemed fit to carry.

3. Number of Persons for Boats.

(1) Subject to certain provisions (see official Rules), the number of persons an open boat shall be deemed fit to carry shall be the number of cubic feet ascertained as in General Rule 2, divided by 10. The space in the boat shall be sufficient for the seating of the persons carried in it, and for the proper use of the oars.

(2) The number of persons a decked boat shall be deemed fit to carry shall be such that the top of the deck amidships shall be at such height above the water as may be approved by the Board of Trade when the

boat is so loaded, subject to there being a deck space of at least four square feet for each person.

Provided, however, that if the boat is so constructed that persons can be accommodated below the deck the Board of Trade may allow a deck space of less than four square feet for each person.

4. Stowage of Boats.

(1) A decked lifeboat may be stowed underneath an open lifeboat, and decked lifeboats may be stowed in sets of three, one above another.

(2) Where a boat is stowed underneath another boat, there shall be provided approved removable supports or other approved appliances, so as to secure that the weight of a boat is not unduly supported by the boat underneath it.

5. Appliances for lowering Boats.

(1) The davits or appliances for lowering boats shall be fitted on one or more of the decks in such positions that the boats can be efficiently lowered from them. Davits shall not be fitted in the bows of a ship, but they may be fitted in any other position in the ship, provided that the boats are not brought into dangerous proximity to a propeller on being lowered into the water.

Where boats are stowed on more than one deck, the arrangements for lowering them shall be such as to prevent the boats from a lower deck being fouled by those from a deck above.

(2) Appliances for getting a boat into the water must fulfil the following conditions:—

Means are to be provided for speedily, but not necessarily simultaneously or automatically, detaching the boats from the falls; the boats placed under davits are to be attached to the falls and kept ready for service; the davits are to be so spaced and placed that the boats can be swung out with facility; the points of attachment of the boats to the falls are to be sufficiently away from the ends of the boats to ensure their being easily swung clear of the davits; the boats' chocks shall be of such construction and arrangement as shall be satisfactory to the Board of Trade. The strength of the davits, falls, blocks, and all other gear required for lowering the boats, shall be to the satisfaction of the Board of Trade; and in the case of foreign-going passenger steamers launched on or after the 1st March, 1913, when the deck from which the passengers will ordinarily enter any boat is 12 feet or more above the centre of the load-line disc, the davits and all the gear shall be of sufficient strength to lower such boat when loaded with its full complement of persons and equipment. The boat's falls are to be long enough to lower the boat into the water with safety when the vessel is light. Life-lines shall be fitted to the davit spans, and shall be long enough to reach the water when the vessel is light. Hooks are not to be attached to the lower tackle blocks.

(3) If a boat is not attached to davits the appliance or appliances or arrangements for getting it into the water must be such as to ensure it being put into the water speedily to the satisfaction of the Board of Trade.

(4) Where more than three boats are served by one set of davits, there shall be provided an approved appliance for lowering the boats in turn and rapidly.

(5) The Board of Trade may accept in lieu of the appliances for lowering boats described in this Rule any other appliance, appliances, or arrangements, which appear to them at least as effective as the appliances herein described.

6. Equipment for Boats and Life-Rafts.

(1) *Boats.*—Every boat which is carried by any ship shall be equipped as follows:—

(*a*) With the full single banked complement of oars and two spare oars.

(*b*) With two plugs for each plug hole, attached with lanyards or chains, and one set and a half of thole pins or crutches, attached to the boat by sound lanyards.

(*c*) With a sea anchor, a bailer, a galvanised iron bucket, a rudder and a tiller, or yoke and yoke lines, a painter of sufficient length, and a boat-hook. The rudder, the bailer, and the bucket shall be attached to the boat by sufficiently long lanyards, and kept ready for use. In a boat where there may be a difficulty in fitting a rudder a steering oar may be provided instead.

(*d*) With a vessel capable of holding one quart for each person that the boat is deemed fit to carry. This vessel shall be kept filled with fresh water, and provided with a dipper with lanyard.

(*e*) With two hatchets, one to be kept in each end of the boat, and to be attached to the boat by a lanyard.

(*f*) With a line securely becketted round the outside of the boat.

(*g*) With an efficient lantern trimmed, with oil in its receiver sufficient to burn eight hours; or with some other lantern or light at least as effective approved by the Board of Trade.

(2) *Life-rafts.*—Life-rafts shall be provided with a suitable approved equipment.

7. Additional Equipment for Certain Boats.

(1) In addition to the equipment prescribed in the preceding Rule, the boats in all classes of foreign-going ships shall be equipped as provided in paragraphs (*a*) to (*e*), inclusive, of this sub-section of this Rule, but not more than half of the boats in a ship of Class 1, foreign-going, or four of them, whichever number is the larger, need have the equipment prescribed in paragraph (*a*). The boats in Classes 1 to 5, inclusive, of the Home Trade shall be equipped as provided in paragraphs (*b*), (*d*), and (*e*) of this subsection of this Rule.

(*a*) With a mast or masts, and with at least one good sail and proper gear for each; but this does not apply to an approved motor boat.

(*b*) With an efficient compass.

(*c*) With an air-tight case containing 2 lbs. of biscuits for each person for whom the boat is approved.

(*d*) With one gallon of vegetable or animal oil, and a vessel of approved pattern for distributing it in the water in rough weather.

(*e*) With one dozen self-igniting red lights in a water-tight tin, and a box of suitable matches in a water-tight tin.

8. Number of Persons for Life-Rafts.

The number of persons that any approved life-raft for use at sea shall be deemed to be capable of carrying shall be determined by the Board of Trade with reference to each separate pattern approved; provided always that for every person so carried there shall be at least 3 cubic feet of strong and serviceable inclosed air-tight compartments, constructed so that water cannot find its way into them.

9. Life-Jackets.

An approved life-jacket shall mean a jacket of approved material and construction, which, if it depends for its buoyancy on air, does not require to be inflated before use, and which is capable of floating in fresh water for 24 hours with 15 lbs. of iron suspended from it. Life-jackets for children shall be of suitable size, and capable of floating in fresh water for 24 hours with 12 lbs. of iron suspended.

10. Lifebuoys.

An approved lifebuoy shall mean either:—

(1) A lifebuoy built of solid cork, capable of floating in fresh water for at least 24 hours with 32 lbs. of iron suspended from it, or

(2) A strong lifebuoy of any other approved pattern and material which is capable of floating in fresh water for 24 hours with 32 lbs. of iron suspended from it, and which is not stuffed with rushes, cork, shavings,

or other shavings, or loose granulated cork, or other loose material, and which, if it depends for its buoyancy on air, does not require inflation before use.

All lifebuoys shall be fitted with beckets securely seized, and at least one on each side of the vessel shall be fitted with a life-line at least 15 fathoms in length. At least half the lifebuoys required in any ship, and not fewer than six in any passenger steamer shall have placed near them, with means for attachment to them, efficient lifebuoy lights, inextinguishable in water, to the satisfaction of the Board of Trade.

3) Self-igniting lifebuoy lights, inextinguishable in water, shall be placed near at least half the number of lifebuoys, and provided with means of attachment.

11. Position of Lifebuoys and Life-Jackets.

All lifebuoys and life-jackets shall be suitably placed to the satisfaction of a Board of Trade Surveyor and so as to be readily accessible to all persons on board; and their position shall be plainly indicated so that it may be known to those for whom they are intended.

For fuller information see Merchant "Shipping Life Saving Appliances," to be purchased from Wyman & Sons, Fetter Lane, London, E.C.

EXTRACTS FROM INSTRUCTIONS AS TO THE SURVEY OF LIGHTS AND SOUND SIGNALS.*

Screens.

1. The screens of side lights, the length of which should never be less than 36 inches from the flame to the chock or its equivalent, are always to be placed parallel to the line of keel, and the lights so screened that the forward edge of the screen, or chock on it, shall be in a line parallel to the keel with the inside edge of the wick. In the case of electric lights, there

* For fuller information see "Instructions as to the Survey of Lights and Sound Signals," to be purchased from Wyman & Sons, Ltd., Fetter Lane, London, E C.

should be a similar screening to the inside edge of the filament. Where the source of light is less than 1 inch in width, as in the case of some circular, duplex, or acetylene burners, the forward edge of the screen or outer edge of the chock should be in a line parallel to the keel with a point measuring 1 inch inboard from the outside edge of the wick, system of wicks, or flame. The screens may be fitted as shown in Figs. 106, 107, and 108. If more than one set of side lights are provided the Surveyors should see that the position of the wick-holder is the same in each set, so that the screens as fitted will in each case be suitable. Should there be any difficulty in having this instruction carried out the case should be reported to the Board of Trade.

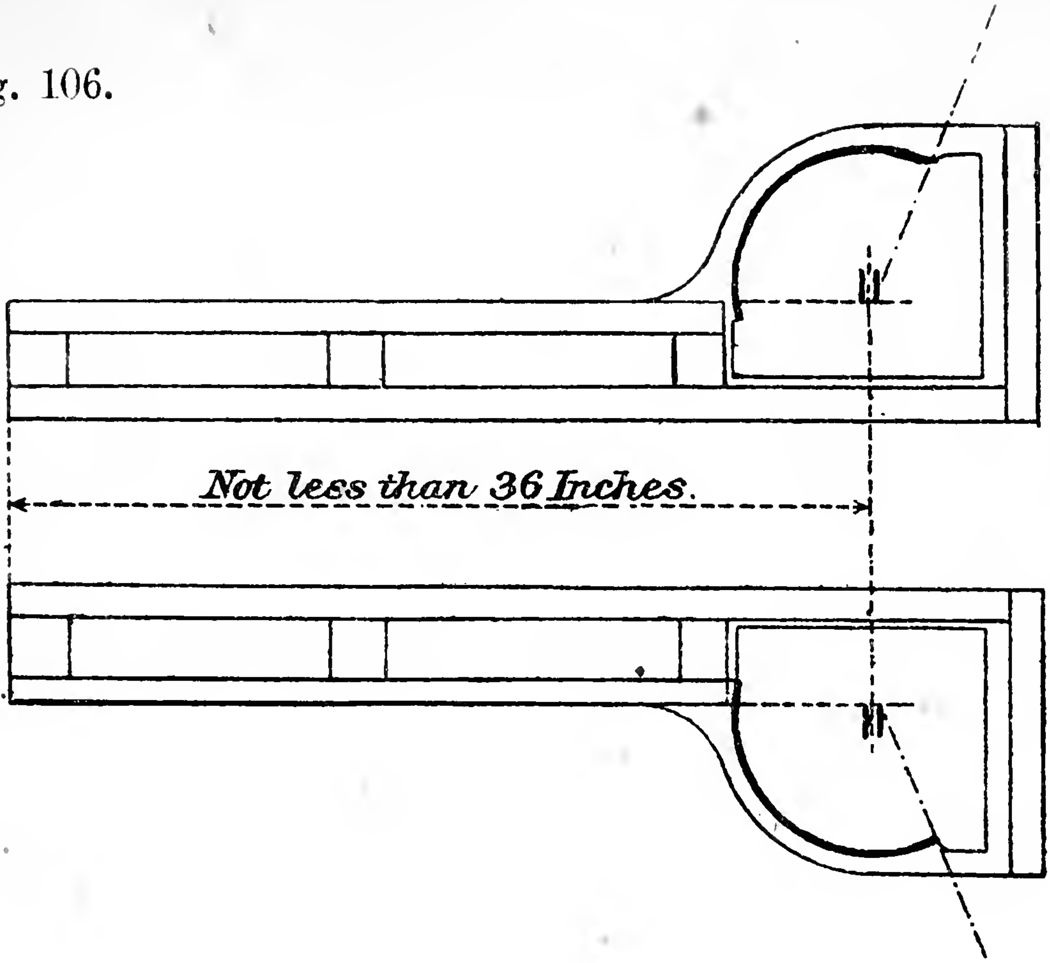
When the screens are of wood, they should be well seasoned, and not less than $1\frac{1}{4}$ inches in thickness; the chock should be at least 2 inches in thickness, and rounded off, as shown in Fig. 107.

The screens are never to be secured to the rigging except in the cases referred to in paragraph 6; when the screens are attached to moveable davits or to outriggers extending outwards over the sides of the vessel, they should be fitted with stop pins or distance rods, so contrived and arranged that when the stop pins are in their places the screens will be parallel with the middle line of the vessel.

The davits or stanchions for supporting the screens should in all cases be of a very substantial character and well fitting, and when they go through the topgallant or main rail they should be carried down into sockets on the covering board or waterway, and have a nut or cotter under the rail to keep them in position.

The screens should be so placed that the lights as screened will not be obscured by any of the equipments of the vessel, such as catheads, boats, boats' davits, sails, rigging, etc., or by passengers or crew moving or standing forward of the lights. To insure this, the lights should be placed as far forward as practicable, and in vessels of very fine entrance, where it may not be possible to carry them far forward, great care should be taken to see that the lamps are so placed that their

Fig. 106.



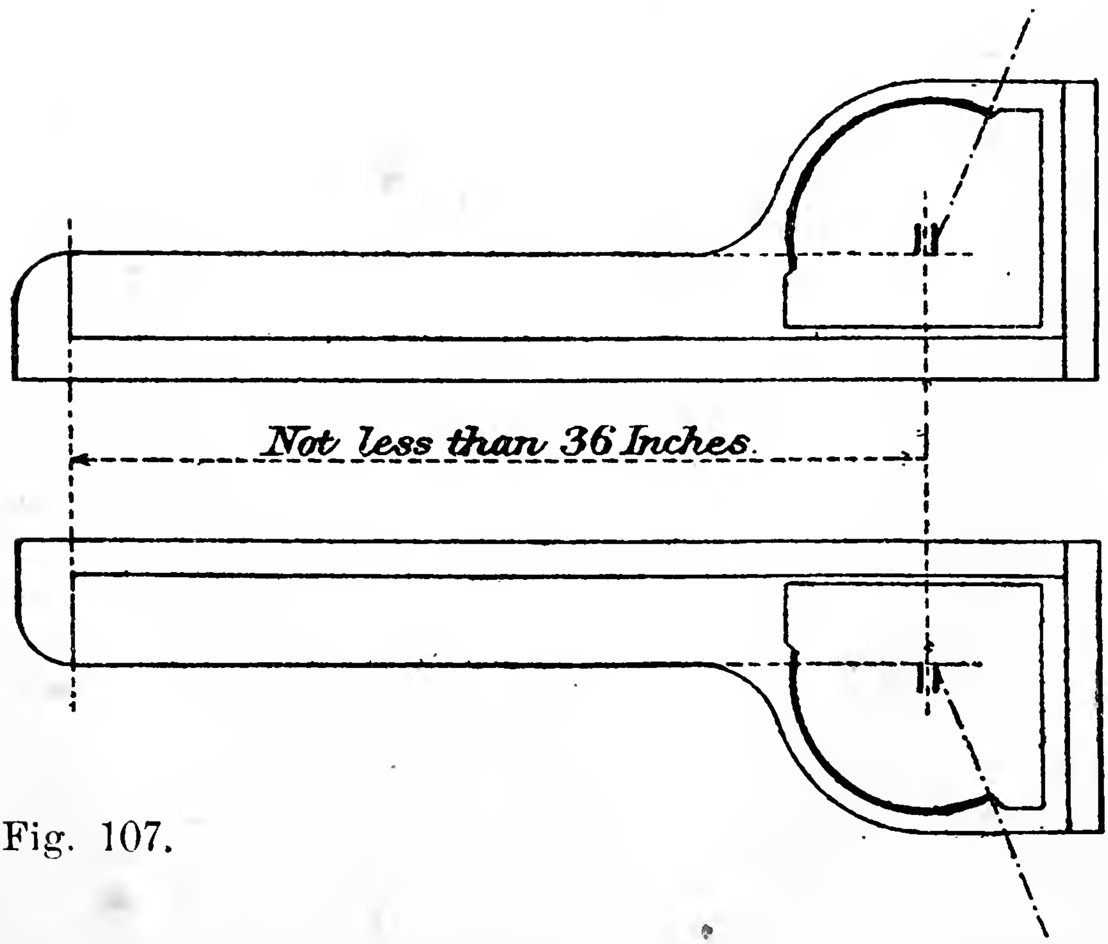


Fig. 107.

SCREENING OF SIDE LIGHTS IN TOWERS.

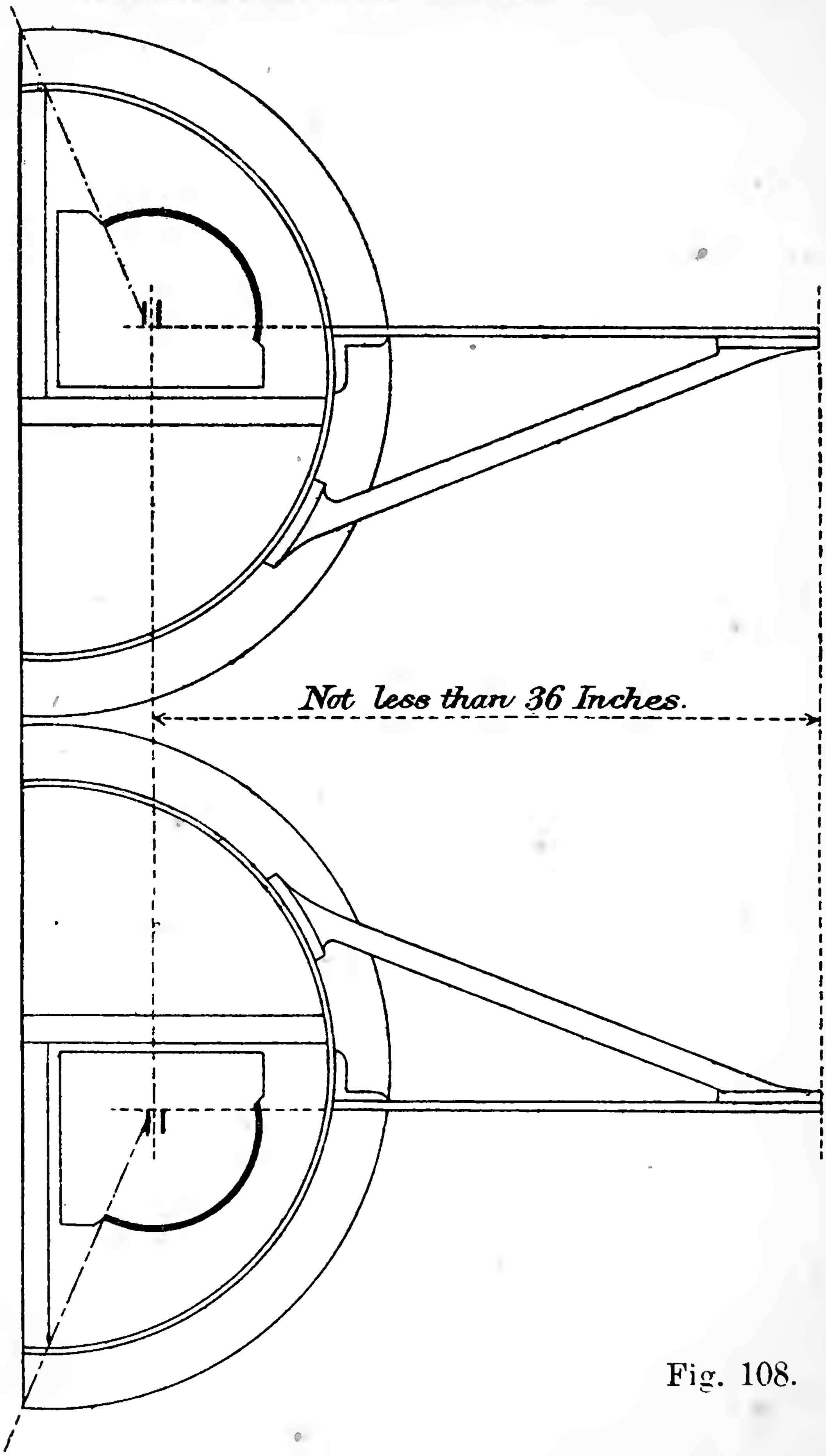


Fig. 108.

rays cannot be intercepted by persons standing or moving about on board. Unless the lights are of a sufficient height above the deck to protect them in this respect, either their height should be increased or they should be placed on properly constructed outriggers at the necessary distance outboard of the vessel. Surveyors are to do their best to insure the side lights of all vessels of 200 tons or over being carried well forward of the midship section of the ship.

Setting of Lens with Reference to Wick.

2. In order to prevent the light from being obstructed by the portion of the lantern which extends over the inner edge of the lens, the Surveyors should see that the lens is so set in the lantern that the rays from the inner edge of the wick pass through the lens and cut the outer edge of the chock. To insure this, it is desirable that the setting of the lens should be well clear of the line between the inner edge of the wick and the outer edge of the chock.

To provide for the unbroken light being visible for two points abaft the beam, the construction of the lantern should be such that a line drawn from the after edge of the wick in the direction of two points abaft the beam cuts the edge of the setting of the lens. Should the wick be placed at right angles to the fore-and-aft line of the ship then the above line should be drawn from the inner edge of the wick.

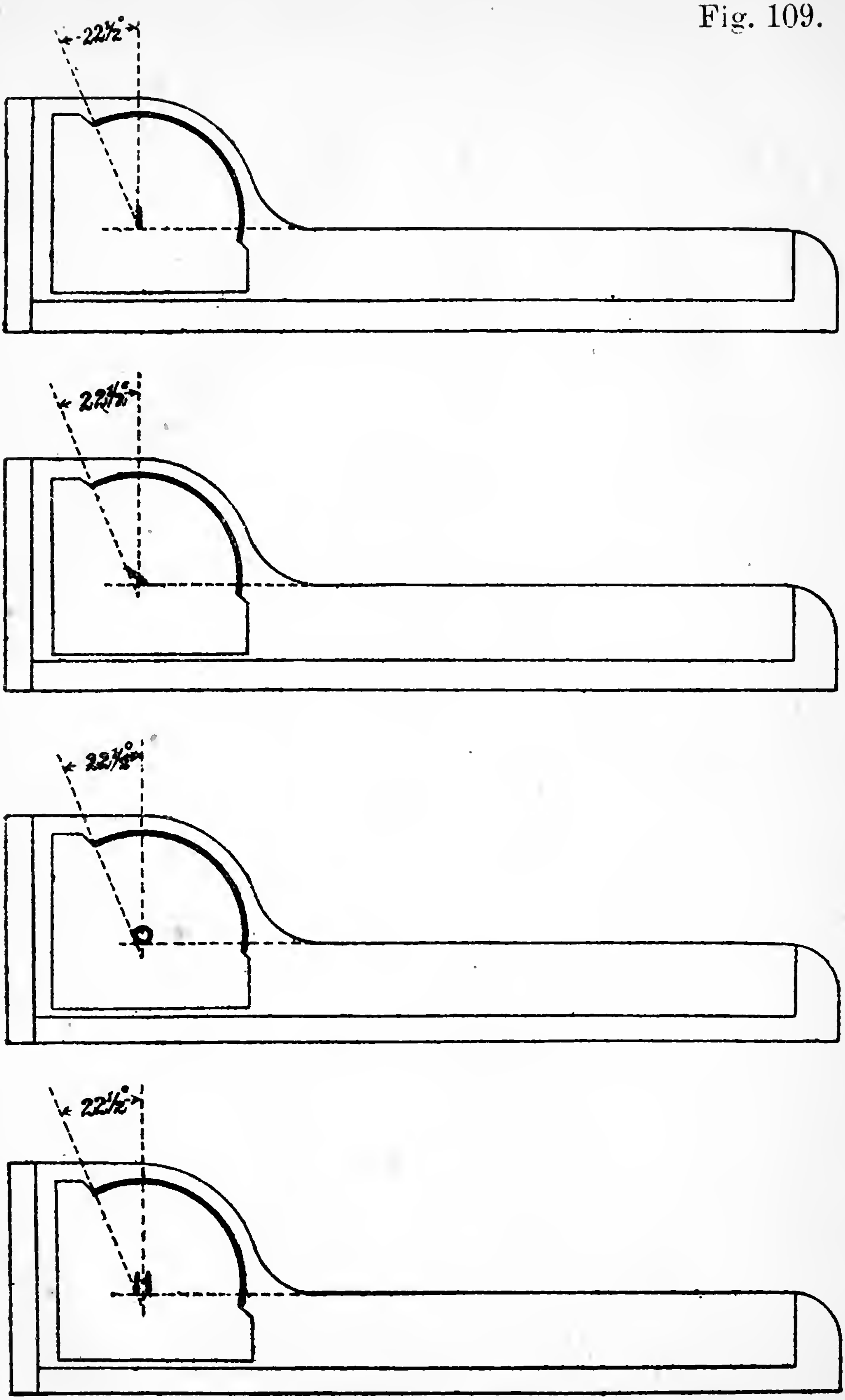
Fig. 109 illustrates the requirements of this clause.

Light-towers.

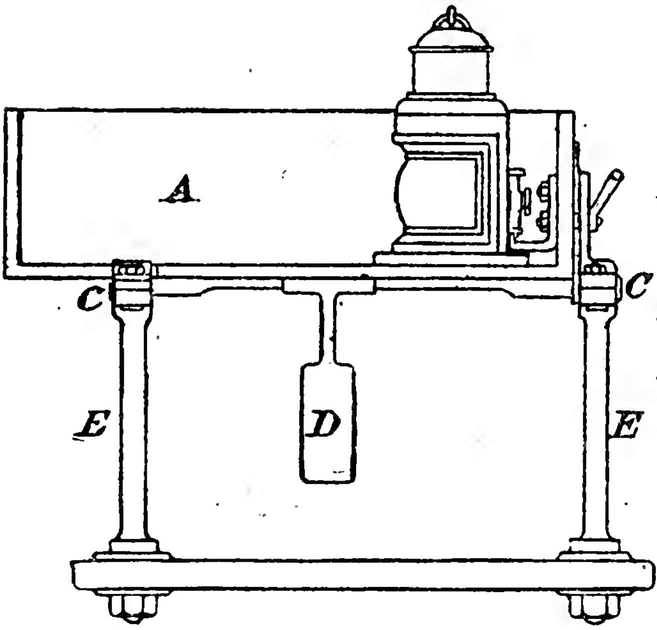
3. Lights which are mounted in light-towers should be carefully inspected, and in the case of new vessels any requisite alterations should be suggested by the Surveyors before their construction is too far advanced. The light-towers should be as far forward in the ship as may be practicable, and if the lights are not then clear of all possible obstructions, the height of the towers must be increased as may be necessary.

Facilities should be provided by means of 1½-inch holes or other apertures, in the light-towers for direct

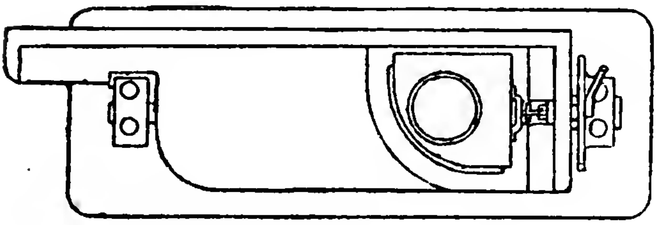
Fig. 109.

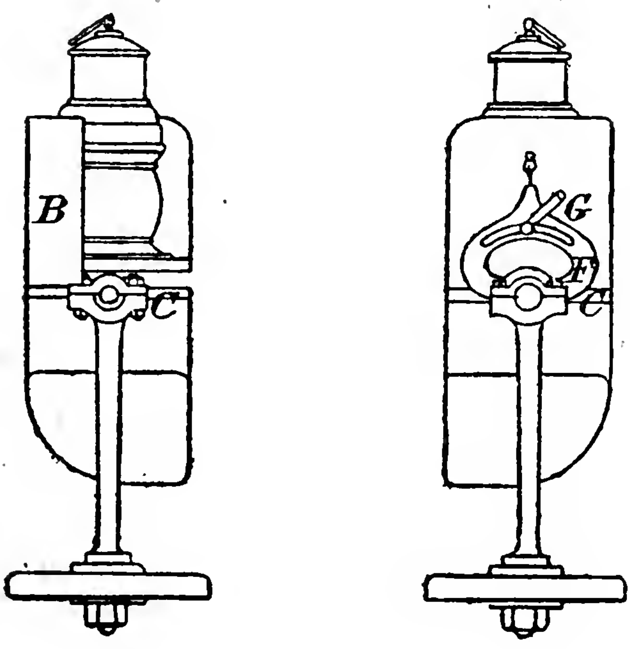


Oscillating Screens. Fig. 110.



A. Screen.
C.C. Pivots of screen.
D. Balance weight
E.E. Stanchions.





B. Chock.
C.C. Pivots of screen
F. Plate fixed to stanchions
G. Screw by which screen may be firmly clamped to plate F at any required angle.

measurement from the wick to a line parallel to the middle line of the ship for the purpose of properly adjusting the screens.

The windows of towers should be made of white glass of the best quality, and should be of such dimensions as to admit of the lights showing in the manner required by the regulations.

Windows consisting of several panes are undesirable, but may be passed if the mullions are set at an angle of 45° from the vertical and do not exceed $\frac{3}{8}$ of an inch in width.

In cases, however, where the lamps have more than one wick, the width of the mullions may be somewhat greater, and their angle from the vertical may be decreased.

To enable lights in towers to show the two miles required by the regulations, they will generally require to have greater illuminating power than those carried in the ordinary manner.

If the Surveyors should find tower windows of unusual construction, or such as to lead them to believe that the lights would not be visible at the distance and in the direction required by the regulations, a test should be made, and full particulars of this and of the lights and windows should be submitted to the Board for consideration.

Gimbals.

4. When side lights are hung on gimbals, the points of suspension of the latter should be in the same horizontal plane as the centre of the lens, in order that the angle at which the most convergent rays cross each other may be practically constant.

Oscillating Screens.

5. The oscillating screens shown in Fig. 110 are considered preferable to gimbals, except for vessels in which the change of fore-and-aft trim is exceptionally great. When the lamps are carried either by gimbals

or oscillating screens the dioptric concentration of the rays by means of the lenses may be carried to a greater extent than is necessary for fixed lamps.

Lights in the Rigging.

6. In the case of small sailing vessels which cannot with safety and convenience of working carry their side lights on stanchions, the lights may be carried in the rigging, provided the Surveyors are satisfied that they are so fitted as to show for the distance and in the direction required by the regulations. This is not to be allowed in case of steamers.

SOUND SIGNALS.

Bells.

7. All steam and sailing vessels must be provided with an efficient bell. The bell should be hung clear of all obstructions, and should not be less than 8 inches in diameter.

Steam Whistles.

8. All steam vessels and all vessels propelled by machinery on the high seas and in all waters connected therewith navigable by sea-going vessels are required to be provided with an efficient whistle or siren sounded by steam or some substitute for steam, and so placed that the sound may not be intercepted by any obstruction. The whistle should be at least 8 feet above the deck, forward of the foremost funnel, and well clear of deck houses, ventilators, etc

Whistle pipes should be so arranged that a full supply of dry steam will at all times be immediately available when the vessel is under way, and, to insure this, if it is possible for water to lodge in the pipes. automatic or other efficient drains which can always be kept open should be fitted.

The pipes should not as a rule, except in small vessels, be less than $1\frac{1}{2}$ inches in bore and should be lagged at least up to the deck.

The whistles of all new vessels should be tried, and unless a full clear sounding blast is immediately produced under all circumstances they should not be passed.

Whistles on Motor Boats.

9. Vessels fitted with electric or oil motor engines, whether auxiliary or otherwise, for propelling purposes are steam vessels within the meaning of the collision regulations, and should therefore be provided with an efficient whistle or siren sounded by steam or some substitute for steam.

If, however, a Surveyor is satisfied that it is impracticable to fit a whistle on any particular vessel of this description he need not detain the vessel, provided an efficient horn, or an efficient electric bell, is on board, and if fixed is so placed that the sound from it will not be unduly obstructed.

In the case of motor vessels plying on rivers or lakes, a horn or electric bell audible for at least a quarter of a mile may be allowed instead of a whistle, if the owners so desire.

Fog Horns.

10. A proper mechanical fog horn, of good power, should be provided in both steam and sailing vessels. The fog horn may be such that it can be blown by steam, or it may be a horn that can be blown by hand It should be of some approved pattern known to emit great and penetrating sound, and it should always be tried.

If a fog horn is fitted to be blown by steam or substitutes for steam it must be supplemented by another to be blown by hand, unless the steam fog horn can be used also by hand.

As, except in the case of sailing vessels and boats of less than 20 tons gross, the signals to be given on the fog horn include "prolonged blasts" of from four to six seconds' duration, all fog horns should be capable of producing a blast of at least four seconds' duration.

Fishing Vessels.

11. The lights and means for making fog signals on fishing vessels will require careful inspection. Special rules are laid down by the Order in Council of October 13th, 1910, as to the lights to be carried by the different classes of fishing vessels when they are fishing or at anchor, and as to the fog signals to be made. When fishing vessels are under way and are not engaged in fishing, they must carry the lights prescribed for vessels of their tonnage under way.

If working lights are used they should be screened in such a manner that they cannot be mistaken for navigation lights.

Mouth fog horns are not sufficient and should not be allowed.

An 8-inch bell need not be insisted on in the case of the smaller vessels, but the Surveyor should be satisfied that the bell provided is efficient.

The form to be used for issuing reports of inspection of the lights and fog signals of fishing vessels is Survey 69a.

STABILITY OF SHIPS.

Q. What is the meaning of *stability*?

Ans. When a ship is heeled or inclined from the upright position through any external force, she immediately endeavours to right herself by means of a force measured in foot tons termed *metacentric stability* or righting moment.

Q. In what manner can a practical knowledge of stability be applied?

Ans. A practical knowledge of stability enables a ship's officer to load a vessel so that she will be in a really seaworthy condition, neither *stiff* nor *crank;* he knows whether she is stable or unstable.

Q. What dangers would you expect in vessels with very great stiffness, also from vessels that are crank or tender?

Ans. The danger from vessels which are very stiff is the severity of their movements whilst rolling. There is no danger of capsising, but they will severely strain themselves with their quick sudden rolls. They have been known to roll their masts overboard and break everything adrift from their lashings on deck.

It is the reverse with the tender vessel; her roll is slow and easy, and the only danger is the very rare possibility of her capsising.,

Q. In calculating problems on stability, what data will it be necessary to know and understand before doing so?

Ans. Displacement, centre of buoyancy, centre of gravity, righting lever, metacentre, metacentric height, metacentric stability, moment of inertia of waterplane, wedges of immersion and emersion, displacement curves, stability curves, metacentre curves, and freeboard.

Explanation of Fig. 111.

W′ L′ is the waterline when ship is upright.
W L is the waterline when ship is heeled.
G is the centre of gravity.
B is the centre of buoyancy.
G Z is the righting lever.
M is the metacentre.
M G is the metacentric height.
L C L′ is the wedge of immersion.
W C W′ is the wedge of emersion.

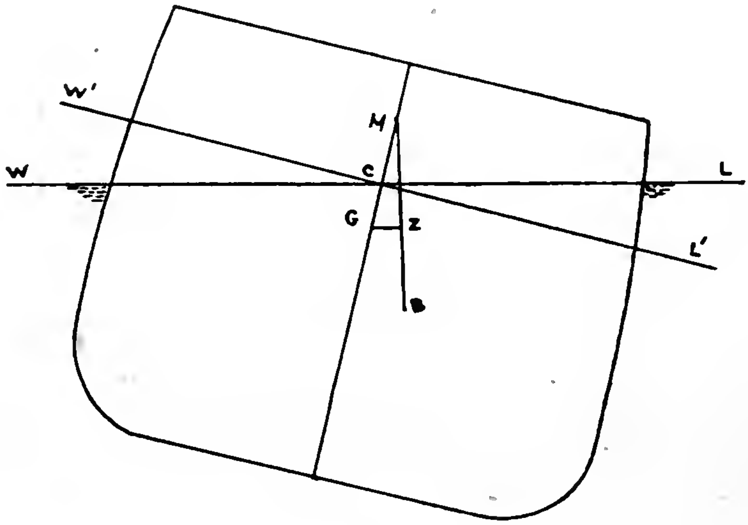


Fig. 111.

Q. What is the meaning of *displacement?*

Ans. Displacement is the weight of water displaced by any vessel whilst floating; it is equal to the weight of the ship, cargo, and everything on board, and increases with the draught of water.

Q. What is the meaning of *centre of buoyancy?*

Ans. The centre of buoyancy is the exact centre of the water displaced or the centre of immersed part of the ship.

Q. What is the meaning of *centre of gravity?*

Ans. The centre of gravity is the point where the whole weight of ship and cargo will balance; this point is the centre of weight.

Q. Explain the meaning of *righting lever.*

Ans. The distance from the centre of gravity to the vertical line passing through the centre of buoyancy. (G Z in Fig. 111.)

It is different for every degree of heel, because the centre of buoyancy moves as the ship heels, the centre of gravity remaining fixed.

When the ship is on an even keel or upright, B and G are in the same vertical line.

Q. What is the *metacentre?*

Ans. The point where the vertical line passing through the centre of buoyancy intersects the centre line at that section of the vessel.

This point M is fixed for small degrees of heel, but when the ship is listed at greater angles, the intersection will vary.

Q. Explain the meaning of *metacentric height.*

Ans. Metacentric height is the distance between the metacentre and centre of gravity. (M to G in Fig. 111.)

This metacentric height varies with different cargoes and different draughts, and mainly depends upon beam and displacement. One of the most important factors in loading a ship is to know the distance between M and G. When this distance is high

G Z, the righting lever, will be great and consequently the righting moment will cause great stability and a "stiff" vessel.

When M G is small, the righting lever G Z will be small, the ship will then be "tender" or "crank."

When M and G coincide, the ship will then be neither stable nor unstable and will not remain upright, she will then list one way or the other according to wind.

A ship with a metacentric height of about one foot ought to be a very good vessel in a high sea.

Q. Explain *metacentric stability.*

Ans. Metacentric stability is the weight in foot tons of the righting moment. It is the righting lever G Z multiplied by the displacement. If G Z was 2 feet and the displacement 4,000 tons, the righting moment or metacentric stability would be 8,000 foot tons.

Q. Explain what is meant by *moment of inertia.*

Ans. Moment of inertia is the measure of the force possessed by the waterplane area of any floating body to remain at rest or motionless.

Q. What is meant by wedges of *immersion and emersion?*

Ans. The spaces between the waterline of a ship when upright and the waterline when heeling are the wedges of immersion and emersion.

L C L′ in Fig. 111 is the wedge of immersion and W C W′ is the wedge of emersion.

Q. What are *displacement curves?*

Ans. Curves constructed to give the ship's displacement for any draught of water.

Q. What are *stability curves?*

Ans. Curves constructed to give the righting levers (G Z) for any degree of heel.

Q. What are *metacentric curves?*

Ans. Curves constructed to give the heights of metacentres for any draught.

Q. Can any information regarding stability be had from the shipbuilder?

Ans. Yes; the shipbuilder of any particular ship can supply:—curves of displacement, curves of "tons per inch," curves of centres of buoyancy, and the position of the metacentre.

These are always the same no matter what kind of cargo may be in the ship, but the centre of gravity is not a fixed point, it is different for every kind of cargo and can seldom occupy the same position twice in succession.

Given the above particulars from the ship builder, the only calculation necessary for the ship's officer is to find the metacentric height, which gives the position of the centre of gravity.

Q. What is the meant by *freeboard*?

Ans. The height of the upper deck at amidships above the waterline at which the vessel floats.

Q. A wooden spar homogenous throughout with a specific gravity of ·5. What kind of stability will it have and how will it float?

Ans. A spar as stated in this question would have neutral stability, that is, neither stable or unstable. It will float as readily in one position as another, because the metacentre and centre of gravity coincide; it has therefore no metacentric height.

With a specific gravity of ·5, it will float with exactly half of its bulk in the water and the other half out.

For calculations and further information on this subject, see any special book on stability.

FORMULÆ.

$$\frac{\text{Length} \times \text{Breadth}^3}{12} = \text{Moment of Inertia of waterplane.}$$

Length $\times$ Breadth $\times$ Draught $=$ Displacement (cubic feet).

(The above are for box-shaped vessels.)

$$\frac{\text{Moment of inertia load waterplane}}{\text{Displacement in cubic feet.}} = \text{Height of metacentre above centre of buoyancy.}$$

Sine angle of heel $\times$ G M $=$ G Z. Where G M $=$ metacentric height and G Z $=$ righting lever, G Z in feet multiplied by displacement in tons equals righting moment in foot tons.

$$\frac{\text{W} \times \text{D}}{\text{Disp.} \times \text{Tang. of heel}} = \text{G M}$$

Where W $=$ weight, D $=$ weight moved, Disp. $=$ Displacement in tons, G M $=$ Metacentric height.

EXAMPLE.—A ship of 5,000 tons displacement has a weight of 24 tons moved from the middle line 15 feet to starboard, which causes a plumb line 9 feet in length to deviate 6 inches. Find the metacentric height.

$$\frac{24 \times 15}{5000 \times \frac{6}{108}} = 1{\cdot}296 \text{ feet (metacentric height).}$$

NOTE.—$\frac{6}{108}$ equals Tang. of heel, 6 inches the shift of plumb line, and 108 inches the length of plumb line.

DEVIATION OF THE COMPASS.
(FOR MASTERS.)

The Examiner's attention is specially called to the importance of Questions 11, 12, 13, 14, and 39, which must be marked in all cases. The other questions must be *constantly* varied.

1. State briefly the essentials of an efficient compass.

Ans. It should be sensible and steady in its action, simple in construction, having two or more short needles with little weight, great directive power, and consequently little friction. The magnetic axis of the needles should be parallel with the North and South points of the card, the cap should be fitted with a ruby or an agate free from punctures, and the pivot hard, sharp, and free from rust. A compass bowl should be made of pure copper.

2. State briefly the chief points to be considered when selecting a position for your compass on board ship, and what should be particularly guarded against?

Ans. It should be placed in the middle line of the ship, easily accessible at all times, raised at such a height to permit bearings to be conveniently observed, and as far as possible from dynamos, and any considerable mass of iron, especially if vertical.

3. What do you mean by Deviation of the Compass and how is it caused?

Ans. Deviation is the angle between the Compass needle and the magnetic meridian, caused by the attraction of iron in the ship.

4. Describe how you would determine the deviation of your compass, (1) by reciprocal bearings; (2) by figures on the dock walls; (3) by bearings of a distant object; (4) by the bearings of the sun or other celestial body.

Ans. (1) A compass is taken on shore and placed clear of all local attraction, the ship is swung and bearings taken with both ship's and shore compass (one to the other) at the same instant; the shore compass bearings reversed are correct magnetic. (2) At Liverpool, Vauxhall Chimney in a line with any of the figures on the dock walls gives the true bearings of the chimney, the variation applied making them magnetic. (3) Determine the correct magnetic bearing of the distant object by a compass on shore, or by swinging the ship and taking the mean of the compass bearings. (4) The true bearing of the celestial body having been computed, apply the variation which will give the correct magnetic bearing. In all the above cases the difference between the correct magnetic bearing and the compass bearing will be the deviation on the ship's head.

5. Having determined the deviation with the ship's head on the various points of the Compass, how do you know when it is Easterly and when Westerly?

Ans. If the correct magnetic bearing be to the right of the compass bearing, the deviation will be East; if to the left West.

6. Why is it necessary, in order to ascertain the deviations, to bring the ship's head in more than one direction?

Ans. Because the deviation alters on every point of the ship's head by compass.

7. For accuracy, what is the least number of points to which the ship's head should be brought for constructing a curve or table of deviations?

Ans. Eight, equi-distant.

8. How would you find the deviation when sailing along a well-known coast?

Ans. By finding the difference between the known correct magnetic bearing of two well defined objects in one line and the compass bearing.

9. Name some suitable terrestial objects by which you could readily obtain the deviation of the compass.

Ans. The following objects in a line:—Tyne leading lights, Beachy Head and Royal Sovereign lightship, Prawle Point and Start, Wolf and Longships, or any two objects in a line whose magnetic bearings are known.

10. Supposing you have no means of ascertaining the magnetic bearing of a distant object when swinging your ship for deviations, how could you find it, approximately, from bearings of the object taken with the ship's head on equi-distant compass points; and at what distance as rule should the object be from the ship?

Ans. The mean value of the equi-distant compass bearings will give the magnetic bearing. The distance from the object should be not less than 6 miles, or at such a distance that the diameter of the space through which the ship swings, will make no sensible difference in the magnetic bearing.

Note.—Rules for Questions 11, 12, 13, and 14, see "Reed's New Guide Book." (Napier's diagram.)

11. Example.—Having taken the following compass bearings of a distant object, find the object's magnetic bearing, and thence the deviation.

MAGNETIC BEARING REQUIRED:—S 8° E.

Ship's Head by Standard Compass.	Bearing of distant object by Standard Compass.	Deviation required.	Ship's Head by Standard Compass.	Bearing of distant object by Standard Compass.	Deviation required.
North	S 4° E	4° W	South	S 13° E	5° E
N E	South	8 W	S W	S 23° E	15 E
East	S 4° W	12 W	West	S 21° E	13 E
S E	S 1° W	9 W	N W	S 11° E	3 E

12. With the deviations as above, construct a curve of deviations on a Napier's diagram, and give the courses you would steer by the Standard Compass to make the following courses magnetic:

Magnetic Courses. S.S.W. W.N.W. N.N.E. E.S.E.

Compass Courses required.
S 13½° W. N 78½° W. N 29½° E. S 56½° E.

13. Suppose you have steered the following courses by the Standard Compass, find the magnetic courses made from the above curve of deviations.

Compass Courses. W.S.W. N.N.W. E.N.E. S.S.E.

Magnetic Courses required.
S 84° W. N 24° W. N 57° E. S 26° E.

14. You have taken the following bearings of two distant objects by your Standard Compass as above; with the ship's head at W ½ S, find the bearings magnetic.

Compass bearing	W. by S. and	N. ¾ W.
Magnetic bearings required	N 87° W.	N 6° W.

15. Do you expect the deviation to change; if so, state under what circumstances?

Ans. Yes; it changes rapidly in a new ship, by change of latitude, heeling over, collision, stranding, very heavy seas, cargo of iron, and by an alteration of the course steered for a long time.

16. How often is it desirable to test the accuracy of your table of deviations?

Ans. Every watch when possible, especially when nearing land, and under circumstances stated in Question 15.

17. What is meant by variation of the compass; what is it caused by; and where can you find the variation for any given position?

Ans. Variation is the angle between the true and magnetic meridians, caused by the magnetic poles not coinciding with the geographical. It may be found for any position on the Admiralty variation chart.

18. The earth being regarded as a magnet, which is usually termed the blue, and which the red magnetic pole?

Ans. The north magnetic pole of the earth is termed the blue, and the south the red.

19. Which end of a magnet (or compass needle) is usually termed the red or "marked" end, and which the blue?

Ans. The north end of a magnet (or compass needle) is termed the red, and the south the blue.

20. What effect has the pole of one magnet of either name on the pole of another magnet?

Ans. Poles of the same name repel, and opposite names attract.

21. What is meant by transient induced magnetism?

Ans. Magnetism induced in soft iron from the earth or from a permanent magnet, which changes as the position is altered. When a ship is kept for a considerable period with her head in a different direction to being built, a change will take place in her magnetic condition, especially if she be subjected to concussion. This change is very transient in duration, when compared with sub-permanent magnetism.

22. Which is the red and which is the blue pole of a mass of soft vertical iron, by induction, and what effect would the upper and lower ends of it have on the compass needle (*a*) in the Northern hemisphere, (*b*) in the Southern hemisphere, (*c*) on the magnetic Equator?

Ans. (*a*) The lower end is red and repels the red end of the needle, the upper is blue and attracts. (*b*) The lower end is blue and attracts the red end of the needle, the upper red and repels. (*c*) Is zero and has no effect, unless retaining previously induced magnetism.

23. Describe what is usually termed the sub-permanent* magnetism of an iron ship, and state when and how it is acquired and which is the red and which is the blue pole, and why it is called sub-permanent magnetism.

Ans. Sub-permanent magnetism is first acquired from the earth's inductive influence while the ship is building, and owing to the hammering remains after she is launched, although it undergoes a considerable reduction, especially through concussion when her head is in a different direction to that of building; for this reason it is called sub-permanent. The red sub-permanent pole is that part of hull which was nearest the north magnetic pole of the earth while building, and the blue the opposite extremity of the ship.

24. Describe the meaning of the expression co-efficient A.

Ans. Co-efficient A is a constant deviation of the same name and amount for any direction of the ship's head, +A signifying Easterly and —A Westerly deviation. It may be caused through the lubber line being misplaced, or an error in the construction of the compass card.

25. Describe the meaning of the expression co-efficient B its sign and effects.

Ans. Co-efficient B represents the fore and aft component of the sub-permanent magnetism, +B representing a force which attracts the north end of the needle towards the bow, and —B towards the stern. It gives semi-circular deviation, and has the greatest amount of deviation at East or West, and

* The term sub-permanent magnetism in these questions is used in the original sense, as proposed by the late Sir G. B. Airey, to denote the character of the permanent magnetism of an iron ship as distinguished from the permanent magnetism of a magnetised steel bar. The terms "sub-permanent" and "permanent" throughout these questions may, therefore, be considered synonymous.

none at North or South. +B gives Easterly deviation in the East semi-circle and Westerly in the West semi-circle, −B gives the reverse.

26. Describe the meaning of the expression co-efficient C its signs and effects.

Ans. Co-efficient C represents the athwartship component of the sub-permanent magnetism, +C representing a force which attracts the north end of the needle towards the starboard side, and −C towards the port side. It gives semi-circular deviation, and has the greatest amount of deviation at North and South and none at East or West. +C gives Easterly deviation in the North semi-circle and Westerly deviation in the South semi-circle, −C gives the reverse.

27. Describe the meaning of the expression co-efficient D its signs and effects.

Ans. Co-efficient D represents magnetism induced in athwartship or fore and aft horizontal iron, and produces quadrantal deviation, having the greatest deviation on the quadrantal and none on the cardinal points, +D from continuous athwartship or divided fore and aft beams, and −D from divided athwartship or continuous fore and aft beams. +D gives Easterly deviation in the NE and SW quadrants, and Westerly in the NW and SE quadrants; −D gives the reverse.

28. Describe the meaning of the expression co-efficient E, its signs and effects.

Ans. Co-efficient E represents magnetism induced in horizontal iron unsymmetrically arranged near the compass. +E gives Easterly deviation in the North and South quadrants and Westerly deviation in the East and West quadrants; −E gives the reverse.

29. Would you expect any change to be caused in the error of your compass by the ship heeling over either from the effect of the wind or the cargo, etc.?

Ans. Yes; from sub-permanent magnetism below the compass, and vertical induction in soft iron.

30. The compasses of iron ships being more or less affected by what is termed the heeling error, on what

courses is this error usually at its minimum, and on what courses at its maximum?

Ans. Minimum at East or West, and maximum at North or South.

31. Describe clearly the three principal causes of the heeling error on board ship.

Ans. (1) Vertical force from the sub-permanent magnetism.
(2) Vertical induction in vertical soft iron, and
(3) Vertical induction in horizontal iron beams.

When the ship heels over the vertical force from sub-permanent magnetism and vertical soft iron below the compass is altered towards the high side and attracts or repels the needle, and the transverse iron becoming inclined to the horizon acquires vertical induction.

32. State to which side of the ship in the majority of cases is the North point of the compass drawn when the ship heels over in the Northern hemisphere.

Ans. High side.

33. Under what conditions (that is, as regards position of ship whilst building, and the arrangement of iron in the ship) is the North point of the compass needle usually drawn to windward or the high side of the ship in the Northern Hemisphere, and if not allowed for, what effect has it on the assumed position of the ship when she is steering on Northerly and on Southerly courses in the Northern hemisphere?

Ans. Ships in the Northern Hemisphere, built with their heads between SW and SE by way of North and having continuous athwartship beams will have the North end of the compass needle drawn towards the high side, and if not allowed for will take the ship to windward on northerly courses, and to leeward on southerly courses.

34. Under what conditions (as in Question 33) is the North point of the compass needle usually drawn to leeward or the low side of the ship in the Northern hemisphere, and if not allowed for, what effect would

it have on the assumed position of the ship, when she is steering on Northerly and on Southerly courses in the Northern hemisphere?

Ans. Ships in the Northern hemisphere, built with their heads between SW and SE by way of South, and having divided athwartship beams with a compass placed between (compass aft) will have the red end of the needle repelled to leeward, and if not allowed for will take the ship to leeward on northerly courses, and to windward on southerly courses.

35. The effects being as you state, on what courses would you keep away, and on what courses would you keep closer to the wind in the Northern hemisphere in order to make good a given compass course, (*a*) when north point of compass is drawn to windward or the high side of ship; and (*b*) when drawn to leeward or the low side?

Ans. (*a*) Keep away on northerly courses, and closer to the wind on southerly courses. (*b*) Reverse to (*a*).

36. Do the same rules (Questions 32—35) hold good in both hemispheres with regard to the heeling error?

Ans. The rule will not hold good (Question 32), if the error from vertical induction in soft iron is greater than the error from the permanent part of the magnetism below the compass; in this particular case the north end of the compass needle will be drawn to the low side in high south latitudes.

The same rule will hold good in the preceding question (Question 35).

37. State clearly how that part of the heeling error due to the permanent part of the magnetism of the ship varies as the ship changes her position on the globe, and what is the reason for it?

Ans. It varies inversely as the earth's horizontal force, and consequently is greatest in high latitudes, diminishes as the ship approaches the magnetic equator where it is least, and increases again in the opposite hemisphere, still retaining the same name. The reason of this is because the directive force of the needle is greatest at the magnetic equator.

38. State clearly how that part of the heeling error due to the induction in transverse iron (which was horizontal when ship was upright) and iron vertical to the ship's deck, varies as the ship changes her position on the globe.

Ans. Decreases as the ship approaches the magnetic equator where it is zero, and is of a contrary name in the Southern Hemisphere.

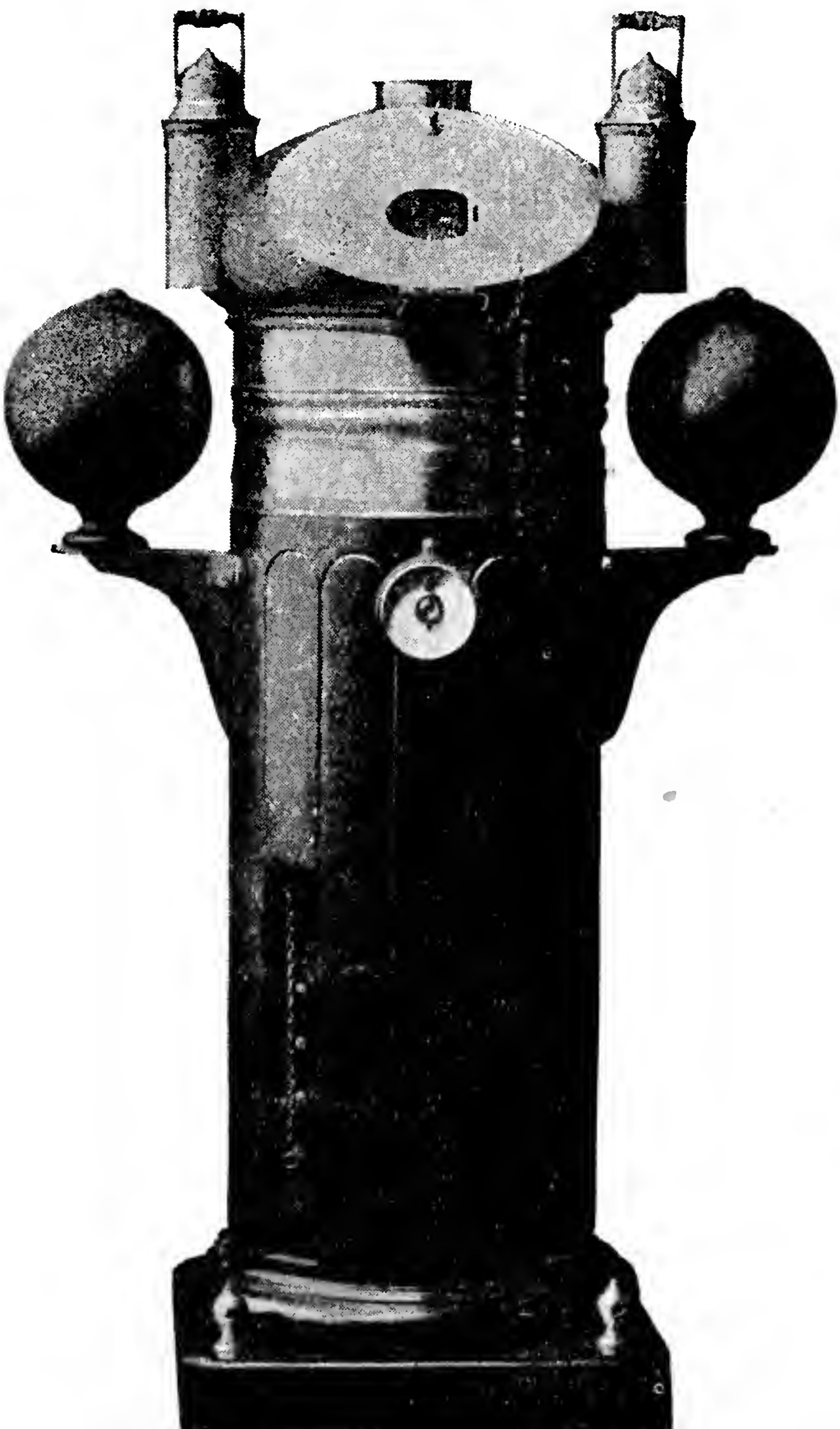


Fig. 111A.

Binnacle shewing soft iron correctors, and holes for the sub-permanent magnetism correctors.

39. Your compass having a large error, show by "Beall's Compass Deviascope" how you would correct it by compensating magnets and soft iron (as usually practised by compass adjusters in the Mercantile Marine) in order to reduce the error within manageable limits. Show also how the heeling error can be compensated.

To be shown on the Deviascope. (See Fig. 119.)

To place the ship's head on any *Magnetic* course by means of the *Polaris*.

Clamp the *sight vane* on the known magnetic bearing of some distant object, also clamp the required magnetic course at the lubber point on the Polaris. Alter the course to starboard or port until the distant object can be seen through the sight vane.

See that the ship is upright, then bring the ship's head North or South (cor. mag.) to correct co-efficient C; place a magnet with its centre on the fore and aft line, and parallel to the athwartships line, move it to or from the Compass till the compass shows the ship's head North or South. Bring the ship's head East or West (cor. mag.), to correct co-efficient B; place another magnet with its centre on the athwartship's line, and parallel to the fore-and-aft line, move it to or from the compass till the compass shows the ship's head East or West. The North poles of these magnets should point in the same direction as the North of the needle is drawn. Bring the ship's head NE, SE, SW, or NW (cor. mag.), to correct co-efficient D; place two soft iron globes, one to port, the other to starboard of the compass (+D), and on the same level with it; move them towards the compass till the compass is again correct.

Diagrams showing how these magnets and soft iron globes are placed.

1st Diagram. Ship's head North or South (Cor. Mag.).

In A (Fig. 112), the North point of the Compass is drawn towards the starboard side (+C), the compensating magnet's North pole must also point towards the starboard side.

In B (Fig. 113), the North point is drawn towards the port side of the compass (– C), the compensating magnet's North pole must also point towards the port side.

Fig. 112.

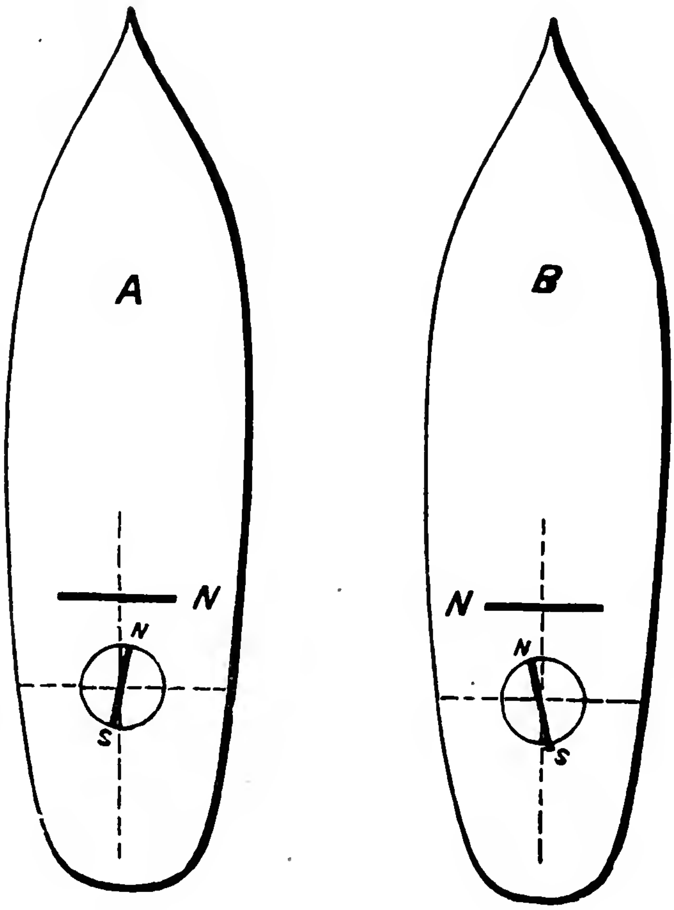


Fig. 113.

+ C — C

Co-efficient C, the athwartship component of the sub-permanent magnetism.

2nd Diagram. Ship's head East or West (Cor. Mag.).

In H (Fig. 114), the North point of the compass is drawn towards the bow (+ B), the compensating magnet's North pole must also point towards the bow.

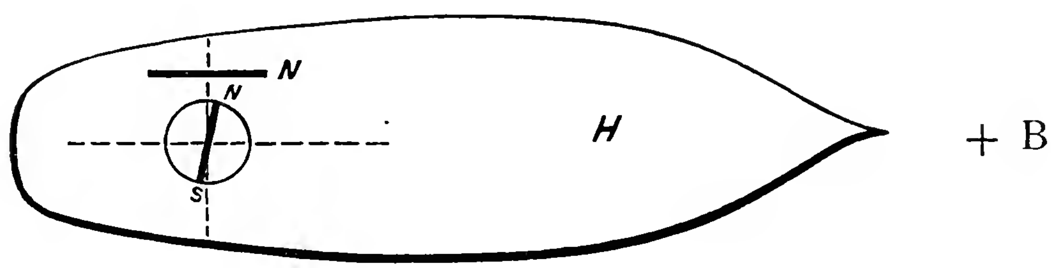
In K (Fig. 115), the North point of the compass is drawn towards the stern (– B), the compensating magnet's North pole must also point towards the stern.

Note.—Co-efficient B consists of two parts, one due to sub-permanent magnetism which has just been corrected, and the other due to induction in vertical soft iron, which will have to be corrected with a soft iron bar at the opposite side of the compass.

If when on the Magnetic Equator the ship's head is brought East or West (Mag.), the whole of the deviation observed on the ship's head will belong to the part due to sub-permanent magnetism. Correct all this deviation with the fore and aft magnet, then when the ship is 10° or more North or South of the Magnetic Equator, bring the ship's head again East or West (Mag.) and correct the deviation observed with the Flinders bar.

The deviation due to the two parts can also be found if the direction of the ship's head when building is known.

Fig. 114.



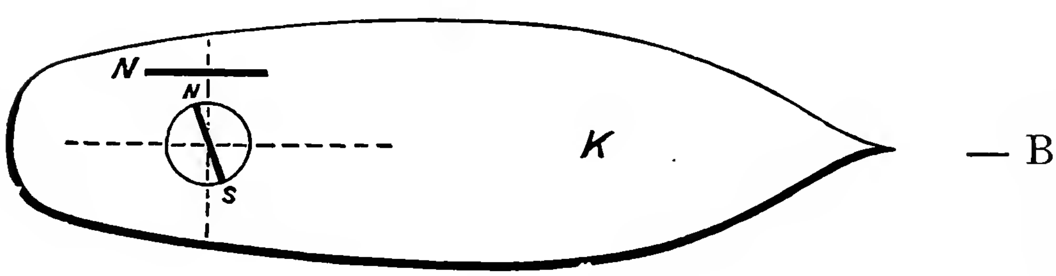


Fig. 115.

Co-efficient B, the fore-and-aft component of the sub-permanent magnetism. (Figs. 115 and 116.)

The deviation observed at North or South is the value of the co-efficient C—. With the direction of the ship's head while building as a *Course*, look in the

Traverse Table and the value of co-efficient C in the *Departure* column will give the value of co-efficient B in the *Latitude* column.

Correct this amount when the ship's head is East or West (Mag.) with the fore and aft magnet and the remainder of the deviation with the Flinders bar.

3rd Diagram. Ship's head NE (Cor. Mag.).

M (Fig. 116) represents the quadrantal deviation. When the ship's head is placed NE or SW, the North point of the compass is drawn to the right as in the diagram; but when her head is NW or SE, the North point of the compass is drawn towards the left (+D). —D is most unusual.

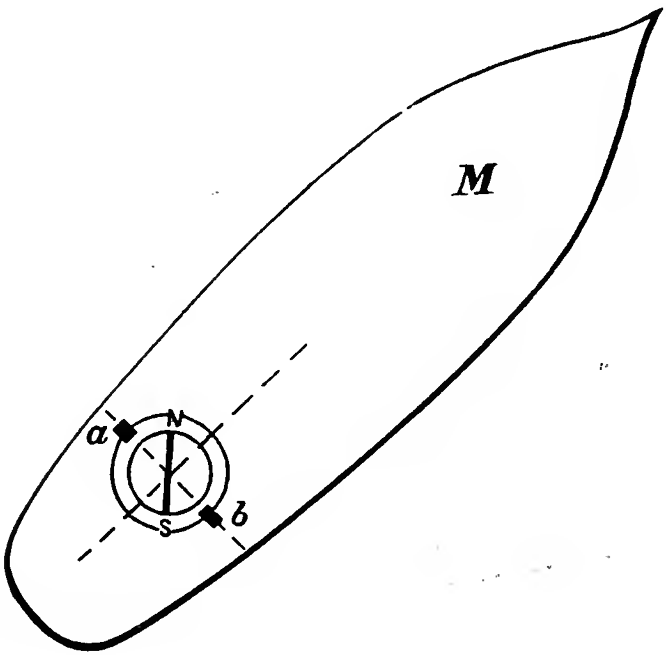


Fig. 116.

In our diagram the soft iron globe (*a*) draws the North point back towards the left, and the globe (*b*) draws the South point to the right, and consequently turns the North point also to the left.

NOTE.—In case of —D the globes would go fore and aft.

The above methods of correcting the compass are on the supposition that the ship is upright. If she heels over to port or starboard, the deviation changes, because the iron that was vertical, is now not quite vertical, and that which was horizontal is no longer so; the sub-permanent magnetism below the compass is also changed to windward.

This heeling error can be compensated by placing a magnet under the centre of the card at right angles with the deck.

1st Method:—

Bring the ship's head North or South and heel her over about 10° to starboard or port; then put the magnet in the place prepared for it in the underneath part of the binnacle, moving it up or down till the compass is corrected.

When a ship heels, it is found that the North of the compass needle is drawn to the high side, in which case the compensating magnet must have its North pole upwards (Fig. 117) but in the few cases where the compass needle is drawn to leeward or low side, this magnet must have its South pole upwards (Fig. 118).

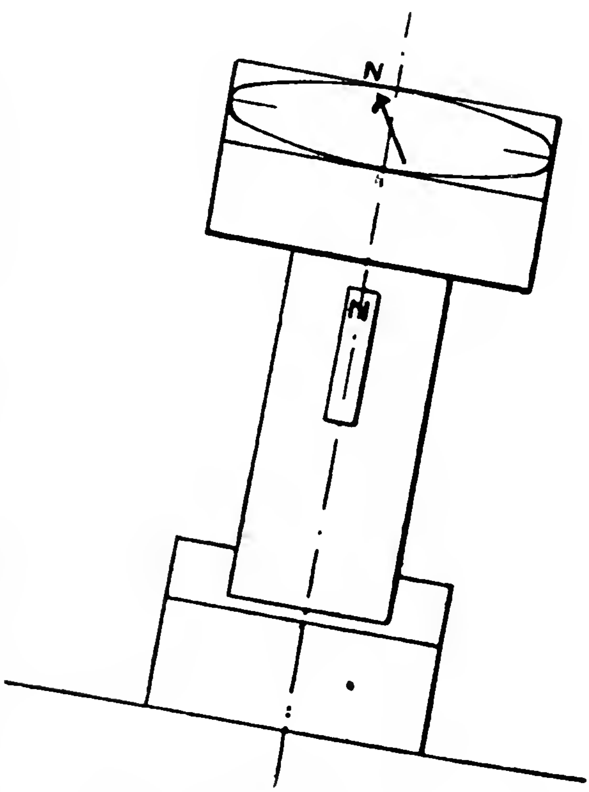


Fig. 117.

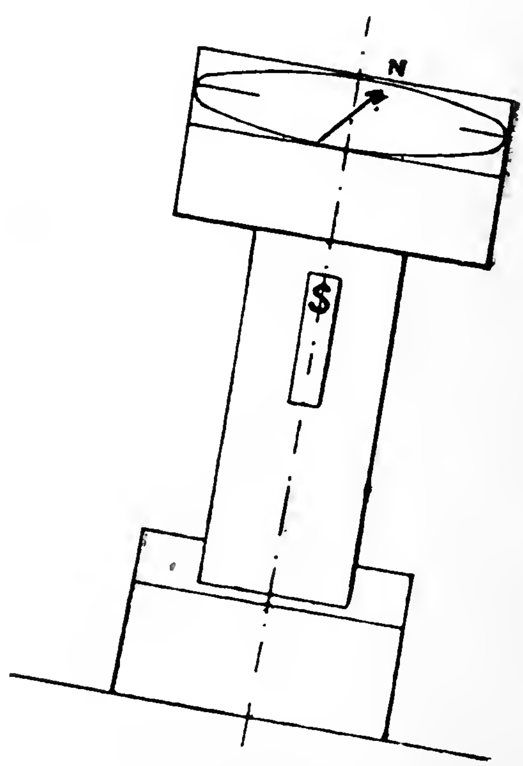


Fig. 118.

See Compass Adjustment page 402.

2nd Method:—

The heeling error can also be corrected with a *Dipping Needle*, when the ship is *upright*.

The Dipping Needle is made to point North and South (horizontal) on shore by means of a small weight which is slid along the needle.

The Dipping Needle is then taken on board of the ship, the ship's head brought East or West (Mag.) and the compass card and pivot unshipped.

The Dipping Needle is then placed in the compass bowl in the same position as the compass card with the North end pointing towards the North magnetic pole of the earth.

This North end of the Dipping Needle will be attracted downwards or repelled upwards by the vertical force in the ship directly under the needle. The Dipping Needle is then made to point *horizontal* by sliding the correcting magnetic under the centre of the compass with its North end upwards when the North end of the Dipping Needle is drawn *downwards*, and the blue end up when repelled *upwards*.

40. As the co-efficient B (capable of being corrected) usually consists of two parts, one due to the permanent magnetism of the ship, and the other to vertical induction in soft iron, how should each of the two parts, strictly speaking, be corrected when compensating the compass?

Ans. That part due to permanent magnetism should be corrected with a bar magnet laid fore and aft, and vertical soft iron corrected with a Flinders bar placed on the fore side of the compass when the disturbing force is abaft the compass.

41. If the whole of the co-efficient B be corrected by a permanent magnet, what is likely to ensue as the ship changes her magnetic latitude?

Ans. Another $+$B or $-$B will probably appear, because the induction in vertical iron changes with the latitude, increasing when the ship is going from, and decreasing when the ship is going towards the

Magnetic Equator; changing the name in the opposite Hemisphere. In high latitudes in the opposite hemisphere, the correcting magnet would increase the error.

42. Provided the needles of your compass are not so long and powerful, and so near, as to cause the soft iron correctors to become magnetised by induction, would the co-efficient D if properly compensated be likely to remain so in all magnetic latitudes and both hemispheres. If so, state the reason why?

Ans. Yes, for although the intensity of inductive magnetism changes with the latitude, the ratio between the directive force and disturbing force remains the same.

43. State at what distance, as a general rule, the magnets and soft iron correctors should be placed from the compass needles, and what will be the consequence if they are placed too near the needles?

Ans. The magnets ought not to be placed within twice their own length from the needles, and the soft iron correctors not within $1\frac{1}{4}$ the length of the needles from the centre of the compass. If too near, the result would be abnormal deviations. (The needles would induce magnetism into the soft iron correctors.)

44. Is it necessary that the magnets used for compensating co-efficients B and C should be placed on the deck. If not, state where they may also be placed, and the rules to be observed in placing them into position.

Ans. No. They must be placed in the binnacle or anywhere near the compass, taking care that the centre of the athwartship magnet is in the fore and aft midship vertical plane, and that the centre of the fore and aft magnet is in the athwartship vertical plane passing through the centre of the compass.

45. Can the compensation of the heeling error be depended upon when the ship changes her latitude? If not state the reason.

Ans. No. Because the heeling error varies as the ship changes her latitude, the correcting magnet retaining its permanency.

46. Describe an artificial magnet, and how a steel bar or needle is usually magnetised.

Ans. An artificial magnet is a tempered steel bar magnetised by the inductive action of another magnet. A general method of magnetising a steel bar is by a horseshoe magnet pressed upon the bar from end to end, the other pole of the magnet should then be brought to the centre of the bar or needle, and drawn several times in the opposite direction. This process should be repeated on the other side of the needle, care being taken that in every case the same pole of the magnet must be drawn to the same end of the needle.

47. Which is the red magnetic pole of the earth, and which the blue; and give their geographical position?

Ans. South magnetic pole (red) in Lat. $72\frac{1}{2}°$ S., Long. 154° E. North magnetic pole (blue) in Lat. 70° N., Long. 97° W.

48. What effect has the pole of one magnet of either name on the pole of the same name of another magnet, and what would be the consequence of the pole of one magnet of either name being brought near enough to affect the pole of contrary name, if in these cases both magnets were freely suspended?

Ans. Poles of the same names repel, and opposite names attract.

49. By applying this law to all magnets, natural as well as artificial, describe what would be the result on a magnetic bar or needle, freely suspended, but by weight or by the nature of its mounting constrained to preserve a horizontal position; and what would be the result, if so mounted, but free to move in every direction; the earth being regarded as a natural magnet?

Ans. The red pole of the needle would be attracted by the blue or North magnetic pole of the earth when horizontal, but if free to move in any direction it would assume a position the angular difference between which and the plane of the horizontal is called the dip. This varies from 0° at the magnetic equator to 90° at the magnetic poles, at London about 68° 30′.

50. What is meant by the term "local attraction"; under what circumstances have ships' compasses, from recent careful investigation, been found to be affected by it, and name some of the localities in different parts of the world where this disturbance is to be found, and consequently where increased vigilance is necessary [*see* Appendix, "Evans' Elementary Manual," 1888].

Ans. Local attraction is a disturbance caused by magnetism outside of the ship. It has special reference to certain places where the compass needle is affected by the magnetism of the ground. A few of the places are Solomon Islands; Sumbawa Island, near Java; Iceland; Odessa Bay; Isle de Los, West coast of Africa; Madagascar; and Cape St Francis, Labrador.

51. What do you understand by the term "soft" iron; and what are its properties as regards acquiring and retaining magnetism?

Ans. Soft iron is instantly magnetised when exposed to any magnetic force, but has no power of retaining it.

52. What do you understand by the term "hard" iron; and what are its properties as regards acquiring and retaining magnetism?

Ans. Hard iron is less susceptible of being magnetised than soft iron, but when once magnetised it retains permanently a large part of the magnetism so received.

53. Describe the meaning of the term "horizontal force" of the earth; where is it the greatest, and where the least, and what effect has it in respect to the increase or decrease of the directive force of the compass needle?

Ans. Horizontal force of the earth is the horizontal component of the total force, it is greatest at the magnetic equator, and zero at the magnetic poles, consequently the directive force of the needle will be increased towards the magnetic equator and decreased towards the magnetic poles.

54. Does the magnetic equator coincide with the geographical equator, if not, state clearly how it is situated?

Ans. No; it is a sinuous line north of the geographical equator from 12° west longitude eastward to 170° west, the remainder being the southward of the true equator. The greatest distance between the two equators is about 10° in the northern hemisphere, and 14° in the southern hemisphere. ("Admiralty Manual.")

55. Where can the values of the magnetic dip, the earth's horizontal force, and the variation be found?

Ans. From charts in the "Elementary and Admiralty Manual."

56. State in what parts of the globe lying in the usual tracks of navigation the variation changes very rapidly, and what special precautions should be observed when navigating these localities; also why a "variation" chart is then very useful.

Ans. North Atlantic, River St Lawrence, South Atlantic, to the southward and to the westward of Australia. In such localities great care should be observed when the course lies at right angles to the lines of equal variations. A variation chart will then be very useful.

57. Why is a knowledge of the magnetic dip, and the earth's horizontal force important in dealing with compass deviations?

Ans. Because it will enable you to ascertain what changes to expect in the deviation as the ship changes her latitude; the magnetic condition of soft iron varies with the dip, and the directive force of the compass needle varies with the earth's horizontal force.

58. Describe the meaning of the term "vertical force" of the earth; where is it the greatest and where the least?

Ans. "Vertical force" is the vertical component of the earth's total force, it is greatest at the magnetic poles, and least at the magnetic equator, where it is zero.

59. Would you expect a compass to be the more seriously affected by any given disturbing force when near the magnetic equator, or near the poles, and state the reason?

Ans. A compass would be more seriously affected near the magnetic poles where there is no directive force, and less seriously at the magnetic equator where the directive force is greatest.

60. State briefly (*a*) the essentials of an efficient compass; and (*b*) what you would consider a good arrangement of the needles (that is—whether long or short, single or double, etc.) with the view to good compensation.

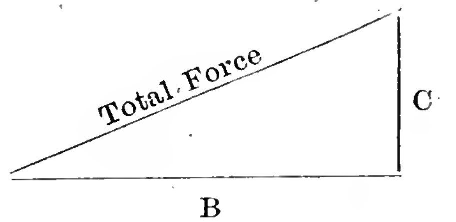
Ans. (*a*) It should be sensible and steady in its action, simple in construction, having two or more short needles with little weight, great directive power, and consequently little friction The magnetic axis of the needles should be parallel with the North and South points of the card, the cap should be fitted with a ruby free from punctures, and the pivot hard, sharp, and free from rust. A compass bowl should be made of pure copper. (*b*) A better compensation would be obtained with a compass having two or more short light needles (an equal number on each side of the centre). The directive force is considerably greater, and an unequal motion common to single needles is avoided.

61. In stowing away spare compass cards or magnets how would you place them with regard to each other, or what might be the probable consequence.

Ans. Place them with their opposite poles next to each other, because if the same poles were placed together, their magnetic force would probably be reduced.

62. What is meant by "the composition of forces" and "the parallelogram of forces," and show how the knowledge of these is valuable in ascertaining and compensating the sub-permanent magnetism of an iron ship.

Ans. The composition of forces is a method to find a single force or resultant from two or more components, and the parallelogram of forces is a graphic method by which this may be done. Unless a ship is built with her head on one of the magnetic cardinal points, the sub-permanent poles will be oblique to the fore and aft midship line, this force is therefore resolved into two components, one fore and aft represented by co-efficient B, the other athwartship represented by co-efficient C. The value of each force being known and represented in magnitude and direction by the adjacent sides of a parallelogram, the diagonal will represent the total force of the co-efficients B and C. The former is compensated by a fore and aft magnet, and the latter by an athwartship magnet.



63. Can semi-circular deviations be produced by any other force than the sub-permanent magnetism of the ship? If so, by what?

Ans. Yes; by magnetism induced in vertical iron.

64. The value of either co-efficient B or C being given, also the magnetic direction of the ship's head while she was being built, determine by the traverse tables the approximate value of the other co-efficient C or B; and the value of both these co-efficients being given determine approximately the direction by compass of the ship's head whilst being built, assuming, of course, that these co-efficients resulted altogether from sub-permanent magnetism.

Ans. Co-efficient B is found in the Lat. coln., C in the Dep. coln., and ship's head top or bottom of the page.

65. Would you expect the greatest disturbance of the needle from the effects of sub-permanent magnetism alone to take place when ship's head is in same direction as when building, or when her head is at

right angles to that direction, and in what direction of the ship's head would you expect to find the least disturbance?

Ans. The greatest disturbance would take place with the ship's head at right angles to the direction she was when building, and the least disturbance with the ship's head in the direction and also in the opposite direction to being built.

66. Describe quadrantal deviation, and state what co-efficients represent it; also on what points, by compass, of the ship's head, each of these co-efficients gives the greatest amount of deviation, and why it is called quadrantal deviation.

Ans. Quadrantal deviation is produced by magnetism induced in horizontal soft iron, it is represented by the co-efficients D and E. D gives the greatest deviation with the ship's head on the quadrantal points, and E with the ship's head on the cardinal points. It is called quadrantal deviation because the deviation changes at every quadrant.

67. State clearly which end of horizontal iron running athwartship (such as beams, etc.) and of horizontal iron running fore and aft of a ship, acquires *red* and which *blue* polarity, by induction, when ship's head is at NE, SE, SW, and NW respectively.

Ans. Athwartship horizontal iron will induce red polarity at the port end and blue at the starboard with the ship's head at NE and SE, and the reverse with the ship's head at SW and NW. Fore and aft horizontal iron will induce red polarity at the fore end and blue at the after end with the ship's head at NE and NW, and the reverse with the ship's head at SE and SW.

68. Describe the nature of the deviation represented by co-efficients $+A$ and $-A$, and describe the errors in the construction of the compass, and other causes, that frequently produce it.

Ans. This co-efficient is a constant deviation of the same name and amount for any direction of the ship's head. $+A$ representing easterly and $-A$ westerly deviation. It may be produced by the needles not being parallel to the North and South lines on the compass card, or from the lubber line being misplaced, also from any error in the magnetic bearing or variation.

69. What is the object of compensating the compass by magnets, etc., and what are the general advantages of a compensated compass over an uncompensated one?

Ans. To reduce the deviation within manageable limits, and equalise the directive force of the needle. The deviations of a compensated compass are more constant, an uncompensated compass will have large changes in the deviation.

70. Before adjusting the compass of an iron ship, what is it desirable to do with the view of eliminating, as far as possible, what may be termed the unstable part of the magnetism of the ship.

Ans. To moor the ship for some time in an opposite direction to being built.

71. Does the B found on board ship usually arise altogether from sub-permanent magnetism, or does part of it usually arise from some other cause or causes?

Ans. No; part of it generally arises from induction in vertical iron, before or abaft the compass.

72. How should each of these two parts of B then, strictly speaking, be compensated?

Ans. That part due to permanent magnetism should be corrected with a bar magnet, and vertical soft iron with the Flinder's bar.

73. Assuming, for the sake of clearness, that your steering compass is unavoidably placed very near to the head of the stern-post (and other vertical iron at the stern), thereby causing a very large —B from induced magnetism; describe briefly any method by which the approximate position for the compensating vertical iron bar (Flinder's or Rundell's) could be estimated in order to reduce the error; describe also how you would proceed, in order to improve, if not to perfect, its position after observations have been made on the magnetic equator.

Ans. Bring the ship's head north or south correct magnetic and determine the value of C, then with the direction of the ship's head while building as a course and the value of C in the Dep. column will give in the Lat. column the value of B due to sub-permanent magnetism, which correct with a magnet having the ship's head east or west, the remaining deviation correct with the Flinder's bar. At the magnetic equator bring the ship's head East or West (magnetic) and correct with a magnet, any deviation appearing at east or west after the ship leaves the magnetic equator correct with the Flinder's bar.

74. State if standard compasses, as well as steering compasses, are generally subject to this disturbance from induced magnetism in vertical iron; also whether the attraction in all cases is found to be towards the stern; and if not, state the conditions under which it might be towards the bow, and how the compensating soft iron bar should then be placed.

Ans. Standard compasses as a rule are generally placed to be clear of any disturbance from vertical iron. If a compass was placed near enough abaft vertical iron (Northern hemisphere) the attraction would be towards the bow, and the Flinders bar would have to be fixed on the after side of the binnacle.

75. Generally speaking, does the magnetism induced in vertical iron usually have any effect in producing the co-efficient C, ship upright, or is it generally produced by sub-permanent magnetism alone? State also your reasons for saying so.

Ans. Co-efficient C is generally produced by sub-permanent magnetism alone. Any vertical iron on one side of the compass is generally counteracted by vertical iron on the other side.

76. Under what circumstances does the character of A and E so change as to render it desirable that these co-efficients should be disregarded or modified?

Ans. When A and E are the result of magnetism induced on one point but retained on some other point of the compass. This may be assumed to be the case if they are both + and the ship swung to the left, and both—when swung to the right. These co-efficients can be modified by swinging the ship right and left handed and taking the mean of the deviations at each point the ship was swung on.

77. Supposing your compasses were allowed to remain uncompensated, explain clearly what would be the probable changes (ship upright) in the deviations produced separately by (1) the sub-permanent magnetism of the ship alone, (2) by the induced magnetism in vertical soft iron (*a*) on reaching the equator, (*b*) in the southern hemisphere.

Ans. The deviations from sub-permanent magnetism would be least at the magnetic equator where the directive force is greatest, and would increase as the ship proceeded into the southern hemisphere. The deviation from vertical iron is zero at the magnetic equator, and increases as the ship proceeds into the southern hemisphere.

78. Assuming you were able to arrive at the proper proportions to be corrected, and were then to exactly compensate the sub-permanent magnetism of the ship by means of a permanent magnet, and the induced magnetism in vertical iron by a soft iron bar, would you expect any deviation to take place in your compass as the ship changed her latitude and hemisphere? And state your reasons for saying so.

Ans. There might be a slight change as the sub-permanent magnetism is liable to change its intensity, while the correcting magnets retain their intensity. The soft iron bar would, if properly placed, be correct for all latitudes, because the magnetism in this iron bar would change at the same ratio as the magnetism in the vertical iron.

79. Supposing the co-efficient D from horizontal soft iron were allowed to remain uncompensated, would you or would you not, expect the D to differ in name or amount on the ship changing her magnetic latitude and hemisphere? And state the reason.

Ans. I should expect the deviation to remain the same, as the ratio between the directive force of the needle and the horizontal induction in iron beams remain the same, in all latitudes.

80. Describe, in detail, how you would determine the deviation of your compass by the bearings of the sun. Also by a star or planet.

Ans. Compute the true bearing of the celestial object by any known method, the difference between the true and compass bearings will be the error of the compass, and the variation applied to the error will give the deviation.

81. Describe the uses to which the Napier's diagram can be applied, and its special advantages.

Ans. A table of deviations can be computed from deviations observed on a few points at either regular or irregular intervals round the compass. Its special advantages are in ascertaining the deviation on any course, compass or magnetic, and in converting compass courses or bearings into magnetic, and the reverse.

82. Describe clearly how the Napier's diagram is constructed.

Ans. The diagram has a mesial line divided into degrees and points running down the centre. On each side of the mesial line are dotted and plain lines intersecting the points of the compass at an angle of 60° to the mesial line, the dotted lines are drawn upwards from right to left, also the plain from left to right. The dotted and plain lines also intersect each other forming equilateral triangles at the mesial line.

83. Nearing land, and being anxious to check your deviations on a few courses you may probably require to steer, what is the least number of points it would be necessary to steady the ship's head upon, if making use of a Napier's diagram, in order to ascertain the deviation on each of the points, say in a quadrant of the compass, and describe clearly how you would do this at sea.

Ans. Ascertain the deviations on the courses at the ends and middle of the quadrant, lay the three deviations on the diagram and draw the (curve,) the deviations may now be had on any course in the quadrant.

84. When swinging your ship, if it be required to construct Deviation Tables for two or more compasses

situated in different parts of the vessel, describe the process, and how you would employ the Napier's diagram for this purpose.

Ans. Note the bearing of the distant object by each compass at the same instant on courses at either regular or irregular intervals round the compass, ascertain the deviation for each compass on these courses, and lay them on separate diagrams for each compass. After drawing the curves the deviation may then be had on every course for any of the compasses, the co-efficients can also be found and a table of deviations constructed.

85. Is a knowledge of the value of the various co-efficients of any advantage? If so, state why.

Ans. Yes; a table of deviations for any particular compass can be computed from them, and the deviations on any point due to the several forces can be seen at a glance. Should there be any change in the deviations, the reason of such change may be ascertained from this table.

86. Describe (*a*) what is commonly known by the term "retentive" or "retained" magnetism, and how the ship acquires it when in port and at sea, (*b*) its effect on the compass needle whilst ship's head continues in the same direction, (*c*) the immediate consequence when the direction of the ship's head is altered, and (*d*) the special precautions to be invariably observed at sea on the alteration of the ship's course.

Ans. (*a*) Retentive magnetism is magnetism induced from the earth but not parted with instantly. A ship acquires it when her head is in one direction for a considerable time either in port or at sea, especially if she is subjected to shocks or strains. (*b*) The only effect will be a slight decrease in the directive force of the needle. (*c*) The needle will be drawn towards the part of the ship that had been south, especially if the ship had been steering east or west. (*d*) Always observe the deviation and if it cannot be obtained the error from retentive magnetism should be guarded against.

87. Describe a "Dumb-card" or "Pelorus," and its use (*a*) in compensating a compass, (*b*) in determining the deviation.

Ans. A "Pelorus" is a circular plate with a compass graduated upon it and fitted with a sight vane, it is free to revolve upon a central pivot, and has a lubber line on the outside rim. (*a*) Fix the lubber line of the instrument towards the ship's head, clamp the sight vane to the known magnetic bearing of the object, set the point required to the lubber line, and swing the ship until the object is visible through the sight vane, the corrector can now be moved until the compass points correct. (*b*) The difference between the ship's head by compass and Pelorus will be the deviation, when the sight vane is clamped to the magnetic bearing on the plate, and turned direct to the object.

88. If you determine the deviation by an azimuth or an amplitude of a heavenly body, it is then combined with variation, which together is sometimes called the *correction* for the compass. State when the deviation is the difference between the variation and the *correction*, and when the sum; and when it is of the same name as that of the *correction*; and when of the contrary name.

Ans. Same names subtract, different names add, to be always named the same as the correction, unless they have same names and the correction is less than the variation.

89. If your correcting magnets are so mounted that their positions can be altered, describe the process by which, on open sea, you can place the ship's head correct magnetic N. (or S.), and correct magnetic E. (or W.), and can make the correction perfect.

Ans. Clamp the sight vane to the computed magnetic bearing of the heavenly body on the dumb card, set the cardinal point to the lubber line and swing the ship until the object is visible through the sight vane. The correctors can now be moved until the compass points correct.

90. Towards which side of the ship would that part of magnetism induced in continuous transverse iron (which was horizontal while ship was upright) help to draw the North point of the needle when ship heels over (*a*) in the Northern Hemisphere, (*b*) in the Southern Hemisphere?

Ans. (*a*) To windward, (*b*) to leeward.

91. Supposing the compass were placed between the two parts of a divided beam or other athwartship iron, towards which side of the ship would iron so situated help to draw the North point of the needle when ship heels over, (*a*) in the Northern Hemisphere, (*b*) in the Southern Hemisphere?

Ans. (*a*) To leeward, (*b*) to windward.

92. Would you expect that part of the magnetism induced in iron exactly perpendicular to the ship's deck, such as stanchions, bulkheads, etc., if below the compass, to cause any part of the heeling error when ship heels over, and if so, towards which side of the ship (*a*) in the Northern Hemisphere (*b*) in the Southern Hemisphere?

Ans. Yes; (*a*) to windward, (*b*) to leeward.

93. If an ordinary standard compass placed higher than the iron top sides be compensated whilst the ship is upright, what co-efficient will be affected by heeling?

Ans. Co-efficient C.

94. If a ship is beating to windward; when she tacks, under what circumstances will the heeling error retain the same name, and under what circumstances will it take the contrary name?

Ans. The heeling error retains the same name when a ship tacks from a Northerly to a Southerly course, and changes the name after tacking, if her head remains on a Northerly or a Southerly course.

95. If a ship is placed on the opposite tack by the change of wind, the ship's course being the same by compass, will the heeling error change its name?

Ans. Yes.

96. In which direction of the ship's head does the heeling error attain its maximum value, and in which direction does it generally vanish?

Ans. Maximum at North or South, and vanishes at East or West.

97. What, then, would be the probable nature of the heeling error, that is, whether to high or low side of the ship, and whether the error would be equal to the sum or difference, etc., of the forces given (1) in high North Latitudes, (2) on magnetic equator, in (3) high South Latitudes? Assuming the polarity of the sub-permanent magnetism of the ship under, and affecting the Compass, to be as given below; the vertical induction in soft iron, of course, obeying the ordinary laws in the above geographical positions (1), (2), (3).

(*a*) In cases where the effect of *red* vertical sub-permanent magnetism is equal to that of the vertical induction in the soft iron of the ship.

(*b*) Where the effect of *red* vertical sub-permanent magnetism is greater than that of the vertical induction in the soft iron.

(*c*) Where the effect of *red* vertical sub-permanent magnetism is less than that of the vertical induction in the soft iron.

(*d*) Where the effect of *blue* vertical sub-permanent magnetism is equal to that of the vertical induction in the soft iron.

(*e*) Where the effect of *blue* vertical sub-permanent magnetism is greater than that of the vertical induction in the soft iron.

(*f*) Where the effect of *blue* vertical sub-permanent magnetism is less than that of the vertical induction in the soft iron.

Ans. (*a*) (1) No heeling error, the difference between the two forces counteract each other; (2) Sub-permanent magnetism repelling to the low side, the soft iron having no effect; (3) The sum of the two forces will repel to the low side.

(*b*) (1) The difference between the two forces will repel to the low side; (2) Sub-permanent magnetism repelling to the low side, the soft iron having no effect; (3) The sum of the two forces will repel to the low side.

(*c*) (1) The difference between the two forces will attract to the high side; (2) Sub-permanent magnetism repelling to the low side, the soft iron having no effect; (3) The sum of the two forces will repel to the low side.

(*d*) (1) The sum of the two forces will attract to the high side; (2) Sub-permanent magnetism attracting to the high side, the soft iron having no effect; (3) No heeling error, the difference between the two forces counteract each other.

(*e*) (1) The sum of the two forces will attract to the high side; (2) Sub-permanent magnetism attracting to the high side, the soft iron having no effect; (3) The difference between the two forces will attract to the high side.

(*f*) (1) The sum of the two forces will attract to the high side; (2) Sub-permanent magnetism attracting to the high side, the soft iron having no effect; (3) The difference between the two forces will repel to the low side.

98. Can the heeling error be compensated? If so state the means to be employed, and how the compensation may be effected.

Ans. Yes, by a vertical magnet under the centre of the compass. A dipping needle having been brought horizontal* on shore by a weight, is brought horizontal on board in the same position as the compass needles by sliding the magnet up or down under the centre of the compass.

99. Do the soft iron correctors used for compensating the co-efficient $+$ D have any effect on the compass needle when the ship heels over, and if so, do they draw the needle towards the low or the high side of the ship, and do they counteract, or otherwise, the effect produced by the vertical induction in the soft iron; (*a*) in the Northern hemisphere, (*b*) in the Southern hemisphere; and what is the reason of this?

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* The above method is sufficiently correct for practical purposes, but because the vertical force on board is usually about $\frac{9}{10}$ths to the force on shore, the needle on shore should be made to dip just a little.

Ans. Yes; they draw the needle to the low side in the Northern hemisphere, and to the high side in the Southern hemisphere, thus producing exactly the opposite effect to vertical induction in soft iron. They will correct for all latitudes in both hemispheres, because the magnetic force in them varies at the same ratio as the vertical induction in the soft iron.

100. Describe any instrument to show the ship's heel (generally called a clinometer), and state how and where it should be fixed.

Ans. A clinometer is a graduated arc fitted with a pointer to show the heel. It is generally fixed on the aft side of the binnacle so that the pointer hangs vertically at 0° when the ship is upright.

101. Should the clinometer be observed when the ship is swung to determine the deviation when the ship is upright? If so, state the reason why.

Ans. Yes; otherwise the observed deviations will be combined with the heeling error.

102. Would you expect the Table of Deviations supplied by the compass adjuster from observations made in swinging the ship to remain good during the voyage or would you expect the deviation to change? If so, state under what circumstances.

Ans. I should not expect the deviations to remain good, especially in a new ship, as the deviations will change as the ship alters her geographical position, also after steering on one course for some time; there will also be a change if she be subjected to sudden blows or shocks from heavy seas and collisions.

103. Is it desirable that a record of your observations for deviations should be kept as a guide for any subsequent voyage in case the ship should be in the same locality, or for further correction of the compass? If so, describe some suitable form for keeping such record.

Ans. It is desirable that a record should be kept, as in cases where observations cannot be obtained you are enabled to shape a course with some confidence. The position of the fore and aft magnet, also the vertical soft iron bar, may also be found. A suitable form is to have a separate page for each point of the compass with the deviations observed in different localities, also the dates, variation allowed, heeling error, if any, and any circumstances connected with the deviation.

104. Would you under any circumstances consider it a safe and proper procedure to place implicit confidence in your compasses, however skilfully they may have been adjusted? If not, what precautions is it your duty to take at all times?

Ans. It is never safe to place implicit confidence in any compass, the deviation should be obtained and recorded at all times.

105. What is meant by terrestrial magnetism, and how is a knowledge of this branch of science useful in an analysis of compass deviation?

Ans. Terrestrial magnetism is a magnetic force which pervades the whole earth, and from whence the magnetic properties of every particle of iron entering into the ship's construction is derived.

In the "Elementary" and "Admiralty" manuals of compass deviation, charts are given where the total force, magnetic dip, horizontal force, vertical force, and variation can be ascertained for any place between latitudes 70° N and 70° S.

The map giving the earth's total magnetic force is arranged in two colours, red and blue, with the magnetic equator separating the blue or north magnetism of the earth from the red or south magnetism. Lines of equal total force are drawn and numbered in absolute measure (British units), and a striking feature on this map is that the points of greatest intensity do not correspond with the magnetic poles.

There are two such points in the northern hemisphere and two in the southern, known as *magnetic foci,* or regions of greatest magnetic force.

At these foci the force is from two to three times the amount of that at the magnetic equator which is represented on the chart by the unit 6·0 and at the strongest foci by 15·2.

Lines of Equal Dip. On this chart it is seen that the dip of the needle at the magnetic equator is 0°, and that the dip gradually increases as the latitude increases until at the magnetic poles, where the dip of the needle is 90°. The rate of increase of dip is not exactly the same for all latitudes, the dip increases more rapidly in low latitudes than it does in high.

Lines of Equal Horizontal Force. On this chart the horizontal force is represented by lines; the strongest near the magnetic equator is numbered 2·1 and gradually decreases to the magnetic poles where the horizontal force vanishes and is numbered 0·0.

Lines of Equal Vertical Force. On this chart the lines of equal vertical force are greatest at the magnetic poles represented by the unit 3·5 and at the magnetic equator 0 where the vertical force is zero.

106. Of what practical use are the charts in the "Admiralty Manual" relating to vertical and horizontal forces, dip, and variation?

Ans. These charts aid the navigator in estimating the probable changes in the deviation of the compass on the ship's change of geographic position.

From the charts of lines of equal vertical force and dip he can estimate the changes that will take place in magnetism arising from vertical induction in soft iron, and from the chart of lines of equal horizontal force he can calculate the changes that will ensue in the deviations arising from the permanent magnetism of the ship; he can also from this chart see at a glance what the directive force of the needle is likely to be for any latitude.

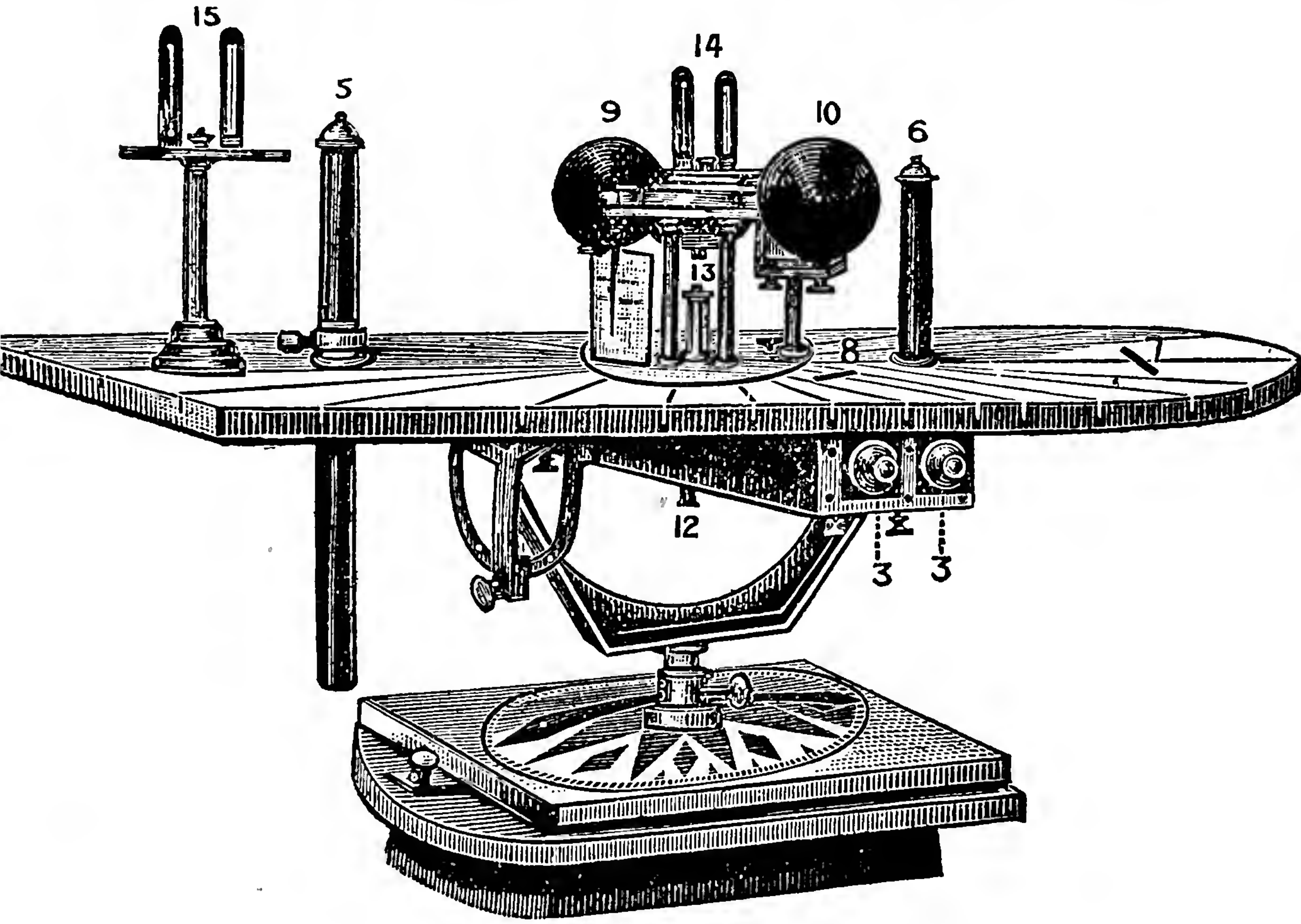
From the chart of lines of equal variation, he can tell the changes that will take place in the variation for any passage, whether great or small, fast or slow, according to his track, which may be at right angles to the lines, or may be parallel to the lines. In the latter case there would be no change, but in the former the change would be rapid.

DESCRIPTION OF THE DEVIASCOPE.

The Deviascope has been invented and produced for the purpose of practically examining candidates at the Board of Trade in Compass Deviation, and for the use of Navigation Schools to practically illustrate the deviation of the compass on board an iron ship, showing how each of the co-efficients is produced, its effect on the compass, and how to compensate and correct the same.

It consists of a large model of a ship's deck, mounted, so that it can be revolved horizontally over a dumb compass card, and also heeled over to port or starboard to any desired angle.

It is fitted with a compass mounted in a brass binnacle or stand, and contains the following fittings as figured on the illustration:—Figs. 3 are two soft iron bars representing the athwartship beams of an iron vessel producing the quadrantal error, or co-efficient D. Another pair of these beams is also supplied, so that a



BEALL'S COMPASS DEVIASCOPE.

Fig. 119.

minus D can be produced. Fig. 5 is a vertical soft iron bar representing the stern post or vertical iron of an iron ship and produces a co-efficient B. Fig. 6 is the Flinders bar for compensating this error. The deck of the Deviascope has 32 radial grooves, and the sub-permanent magnetism or co-efficients B and C are produced by dropping a pair of bar magnets into the opposite ends of one of these grooves, according to the direction it is assumed the ship's head was on building. Figs. 7 and 8 are the deck magnets for compensating this. Figs. 9 and 10 are the soft iron balls for correcting the quadrantal error; they can be moved to and from the compass, and the ring which carries them can also be revolved in azimuth to correct minus D. Fig. 12 is a magnet to produce the heeling error; and Fig. 13 is the small magnet fitted in the binnacle to compensate this. Fig. 14 is the azimuth sights fitted on compass, and Fig. 15 a small Pelorus or dumb card with sights.

A clinometer is fitted on front of the binnacle to show the heel of the model.

COMPASS ADJUSTMENT.

The TENTATIVE METHOD of COMPASS ADJUSTMENT as generally practised by COMPASS ADJUSTERS in SHIPS of the MERCANTILE MARINE.

Before describing the practice, it will be as well to briefly state the co-efficients used to express the different magnetic forces:—

Co-efficient A represents a constant quantity.

,, B ,, semi-circular deviation due to fore and aft magnetic forces.

,, C ,, semi-circular deviation due to transverse magnetic forces.

,, D ,, quadrantal deviation due to horizontal induction in soft iron.

,, E ,, quadrantal deviation due to horizontal induction in soft iron, unsymmetrically distributed.

Signs and Effects of Co-efficients A, B, C, D, and E

Co-efficient A represents a constant deviation of the same nature and amount, on all points of the compass; + A signifying easterly, and — A westerly deviation.

Co-efficient + B represents an attraction towards the ship's head, and causes easterly deviation with ship's head in the eastern semi-circle of the Compass; and westerly deviations in the western semi-circle, attaining a maximum value on the east and west points, decreasing to zero on north and south points, by Compass.

Co-efficient — B represents an attraction towards the ship's stern, and causes easterly deviations with ship's head in the western semi-circle, and westerly deviations with the ship's head in the eastern semi-circle, with a maximum value on the east and west points, decreasing to zero on the north and south points, by Compass.

Co-efficient + C represents an attraction towards the starboard side of the ship, and causes easterly deviations with ship's head in the northern semi-circle, and westerly deviations in the southern semi-circle, attaining a maximum value on the north and south points, decreasing to zero on the east and west points of Compass.

Co-efficient — C represents an attraction towards the port side of the ship, and causes westerly deviations with ship's head in the northern semi-circle, and easterly in the southern semi-circle, attaining a maximum value on the north and south points, decreasing to zero on the east and west points by Compass.

Co-efficient + D gives easterly deviations with ship's head between N. and E., and S. and W.; and westerly deviations between S. and E., and N. and W.

Co-efficient — D gives results exactly the reverse to + D.

> Note.—Both + D and — D have a maximum value on the four quadrantal points, and become zero on the cardinal points, by Compass.

Co-efficient $+E$ gives easterly deviations with ship's head between N.E. and N.W., and S.E. and S.W.; and westerly deviations between N.E. and S.E., and N.W. and S.W.

Co-efficient $-E$ gives results exactly the reverse to $+E$.

> NOTE.—Both $+E$ and $-E$ have a maximum value on the cardinal points, and become zero on the four quadrantal points, but are usually very small in amount in Compasses placed in the middle line of the ship.

Heeling Error. The heeling error arises partly from vertical induction in transverse iron, and iron vertical to the ship's deck, and partly from the vertical component of the sub-permanent magnetism of the ship. In the Northern Hemisphere in the majority of cases the N. point of the Compass needle is drawn to windward or the high side of the ship, with, as a rule, a maximum heeling error on N. and S. points, and zero on E. and W. points by Compass. If the Compass is not properly placed in the ship there may be a sensible heeling deviation on E. and W. Courses.

TENTATIVE CORRECTIONS.

To correct Co-efficient C. With ship's head north or south, magnetic, place a bar magnet (or more than one if necessary) horizontally and exactly athwartship, either on the deck or on any convenient platform, with its centre on the fore and aft line passing through the centre of the Compass card, placing its red or marked end to starboard, if the N. point of the needle deviates to the starboard side or to port if it deviates to the port side of the ship, moving the magnet to or from the Compass until it points correctly.

> NOTE.—The deviation represented by co-efficient C varies inversely as the earth's horizontal force, providing the iron is symmetrically arranged on each side of the Compass.

To correct Co-efficient B. With ship's head east or west, magnetic, place a bar magnet (or more than one if necessary) horizontally and exactly parallel to the fore and aft midship line of the ship, either on the deck or on any convenient platform, with its centre on the athwartship line passing through the centre of the Compass, the red or marked end of the magnet being directed aft if the N. point of the Compass needle deviates towards the stern, or forward if it deviates towards the bow, moving the magnet to or from the Compass until it points correctly.

> NOTE.—The co-efficient B consists of two parts; one is due to the permanent magnetism of the ship, which varies inversely as the earth's horizontal force; the other to vertical induction in soft iron, which varies as the tangent of the dip. As ships in the Merchant service are rarely built with a view of providing a satisfactory position for the standard Compasses, it is very difficult in many ships to find a position for it where it will not be affected by vertical iron. It follows therefore, that if this deviation be compensated as is customary, by a fore and aft permanent magnet instead of by a vertical soft iron bar, the poles of the magnet may in some cases require to be reversed in high southern latitudes.

To correct Co-efficient +D. With ship's head on one of the quadrantal points, magnetic, the +D is generally corrected by boxes of small chain, cylinders of soft iron, or soft iron globes, placed athwartships on the same level, and at equal distances, on the port and starboard side of the Compass, with the centre of their mass on a level with the Compass needle, move them to or from the Compass till the needle points correctly.

To correct Co-efficient —D. Co-efficient —D which is of very rare occurrence, is corrected by placing the above correctors on the fore and aft sides of the Compass.

> NOTE.—When once the co-efficient D is properly corrected by soft iron it is corrected for all magnetic latitudes, provided the distribution of the iron in the ship is not materially

changed, and provided the magnetism of the soft iron has not been affected by the Compass needles. With short needles having small magnetic power, such, for instance, as Sir Wm. Thomson's there will probably be no change; but when the needles are long and powerful, one half the original D may be expected to return when approaching the magnetic equator. *See* Admiralty Manual, 1882, page 96 as follows—"When a compass with "long and powerful needles is employed soft "iron correctors placed very near it become "magnetised by induction according to the "power of the needles, and the resulting cor- "rection will not remain strictly perfect in "all latitudes."

To correct Heeling Error. The heeling error is corrected for any given magnetic latitude by placing a vertical magnet exactly under the centre of the Compass card, with its N, or red pole uppermost if the heeling error is to windward or to the high side of the ship, or its S, or blue end uppermost if to leeward or to the low side of the ship moving the magnet to or from the Compass until the heeling error is corrected.

NOTE.—The heeling error due to the permanent part of the magnetism varies inversely as the earth's horizontal force, and consequently is greatest in high latitudes, diminishes as the ship approaches the magnetic equator, and increases again, still retaining the same name, as the ship recedes from the magnetic equator, in the Southern Hemisphere. The heeling error due to transverse and vertical soft iron decreases as the ship approaches the magnetic equator, where it is zero, and is of a contrary name in the Southern Hemisphere. It is probable that the poles of the vertical magnet may require to be reversed in high Southern latitudes.

A divided scale should be marked or fitted outside the tube or some other convenient place, so as to show the proper position for the correcting magnet as found in any given magnetic latitude, and the same recorded as a guide for approximately placing the magnet in position on any subsequent voyage in the same locality, and especially on the return of the ship to the United Kingdom.

Candidates should understand that the object of tentative adjustment is to bring the deviations within manageable limits, and also to equalise the directive force of the needle so far as is practicable on all courses; but no system of adjustment whatever is sufficiently reliable in character to absolve the navigator from the necessity of using every precaution, and especially of ascertaining the deviation on every available opportunity by observations of the sun by day, and the other heavenly bodies by night.

TO CALCULATE THE DISTANCE FROM A GUN.

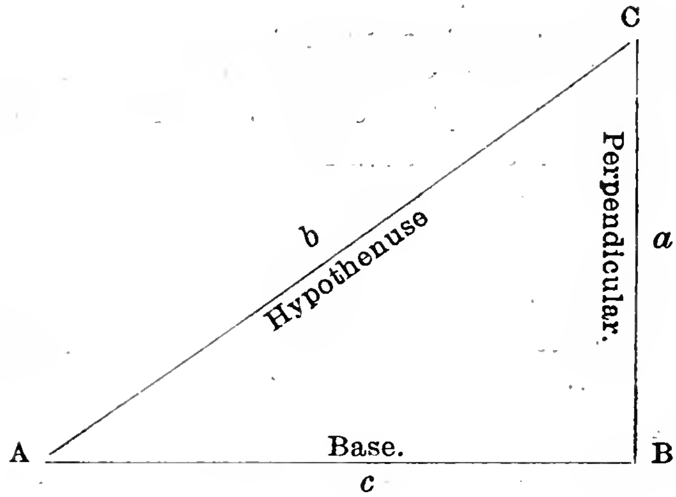
Note the time when the smoke is seen, and note the time when the report is heard.

The interval is the time taken for the sound to travel to the observer.

Sound travels at the rate of 1090 feet per second, at a temperature of 32° Fahrenheit, and the speed is increased 1·15 feet per second for each degree above freezing point.

TRIGONOMETRY.

RATIOS.	RECIPROCALS.
1. Sin. $A = \frac{a}{b}$ or $\frac{\text{perp.}}{\text{hyp.}}$	4. Cosec. $A = \frac{b}{a}$ or $\frac{\text{hyp.}}{\text{perp.}}$
2. Sec. $A = \frac{b}{c}$ or $\frac{\text{hyp.}}{\text{base.}}$	5. Cos. $A = \frac{c}{b}$ or $\frac{\text{base.}}{\text{hyp.}}$
3. Tan. $A = \frac{a}{c}$ or $\frac{\text{perp.}}{\text{base.}}$	6. Cotan. $A = \frac{c}{a}$ or $\frac{\text{base.}}{\text{perp.}}$



NOTE.—Ratios similar to the following are given to all candidates. As they have not yet appeared in the Guide Books for Mates and Masters, a few are here inserted.

I. (By Euc. I. 47) $BC^2 + AB^2 = AC^2$

Dividing No. I equation by AC^2, we have $\frac{BC^2}{AC^2} + \frac{AB^2}{AC^2} = \frac{AC^2}{AC^2}$

$\therefore (a)\ldots \quad \text{Sin.}^2\,A + \text{Cos.}^2\,A = 1$

From which we obtain,

$(b)\ldots \quad \text{Sin. } A = \sqrt{1 - \text{Cos.}^2\,A}$

and $(c)\ldots \quad \text{Cos. } A = \sqrt{1 - \text{Sin.}^2\,A}$

II. Dividing No. I equation by AB^2, we have $\frac{AC^2}{AB^2} = \frac{AB^2}{AB^2} + \frac{BC^2}{AB^2}$

$\therefore (a)\ldots \quad \text{Sec.}^2\,A = 1 + \text{Tan.}^2\,A$

III. Dividing No. I equation by BC^2, we have $\frac{AC^2}{BC^2} = \frac{BC^2}{BC^2} + \frac{AB^2}{BC^2}$

$\therefore (a)\ldots \quad \text{Cosec.}^2\,A = 1 + \text{Cot.}^2\,A.$

IV. (*a*) $$\text{Sin. A} \times \text{Cosec. A} = \frac{BC}{AC} \times \frac{AC}{BC} = 1$$

$$\therefore \text{ Sin. A} = \frac{1}{\text{Cosec. A}}$$

and $$\text{Cosec. A} = \frac{1}{\text{Sin. A}}$$

(*b*) $$\text{Tan. A} \times \text{Cot. A} = \frac{BC}{AB} \times \frac{AB}{BC} = 1$$

$$\therefore \text{ Tan. A} = \frac{1}{\text{Cot. A}}$$

and $$\text{Cot. A} = \frac{1}{\text{Tan. A}}$$

(*c*) $$\text{Sec. A} \times \text{Cos. A} = \frac{AC}{AB} \times \frac{AB}{AC} = 1$$

$$\therefore \text{ Sec. A} = \frac{1}{\text{Cos. A}}$$

and $$\text{Cos. A} = \frac{1}{\text{Sec. A}}$$

V. (*a*) $$\text{Tan. A.} = \frac{\text{Sin. A}}{\text{Cos. A}}$$

$$\frac{BC}{AB} = \frac{\frac{BC}{AC}}{\frac{AB}{AC}} = \frac{BC}{AC} \times \frac{AC}{AB} = \frac{BC}{AB}$$

$$\therefore \text{ Tan. } A = \frac{\text{Sin. } A}{\text{Cos. } A}$$

$$(b) \text{ Cot. } A = \frac{\text{Cos. } A}{\text{Sin. } A}$$

$$\frac{AB}{BC} = \frac{\frac{AB}{AC}}{\frac{BC}{AC}} = \frac{AB}{AC} \times \frac{AC}{BC} = \frac{AB}{BC}$$

$$\therefore \text{ Cot. } A = \frac{\text{Cos. } A}{\text{Sin. } A}$$

NUMERICAL VALUE OF ANGLES.

In triangle ABC, when A = 30°, C will equal 60° and side AC will be twice CB.

When A = 45°, C will also = 45°, and side AB will be equal to side CB.

No. VI are the values for angles of 30° and 60°, No. VII for angles of 45°.

VI. (*a*) $\text{Sin. } 30° = \frac{BC}{AC} = \frac{\frac{1}{2} AC}{AC} = \frac{1}{2} = \text{Cos. } 60°.$

(*b*) $\text{Cos. } 30^\circ = \sqrt{1 - \text{Sin}^2\, 30^\circ} = \sqrt{1 - (\tfrac{1}{2})^2}$

$= \sqrt{1 - \tfrac{1}{4}} = \sqrt{\tfrac{3}{4}} = \dfrac{\sqrt{3}}{2} = \text{Sin. } 60^\circ.$

(*c*) $\text{Tan. } 30^\circ = \dfrac{\text{Sin. } 30^\circ}{\text{Cos. } 30^\circ} = \dfrac{\frac{1}{2}}{\frac{\sqrt{3}}{2}} = \dfrac{1}{2} \times \dfrac{2}{\sqrt{3}} = \dfrac{1}{\sqrt{3}}$

$= \text{Cot. } 60^\circ.$

(*d*) $\text{Sec. } 30^\circ = \dfrac{1}{\text{Cos. } 30^\circ} = \dfrac{1}{\frac{\sqrt{3}}{2}} = \dfrac{1}{1} \times \dfrac{2}{\sqrt{3}} = \dfrac{2}{\sqrt{3}}$

$= \text{Cosec. } 60^\circ$

(*e*) $\text{Cot. } 30^\circ = \dfrac{\text{Cos. } 30^\circ}{\text{Sin. } 30^\circ} = \dfrac{\frac{\sqrt{3}}{2}}{\frac{1}{2}} = \dfrac{\sqrt{3}}{2} \times \dfrac{2}{1}$

$= \sqrt{3} = \text{Tan. } 60^\circ.$

(*f*) $\text{Cosec. } 30^\circ = \dfrac{1}{\text{Sin. } 30^\circ} = \dfrac{1}{\frac{1}{2}} = \dfrac{1}{1} \times \dfrac{2}{1} = 2$

$= \text{Sec. } 60^\circ.$

For Angles of 45°.

VII. (*a*) Since $AC^2 = BC^2 + AB^2$, and $BC = AB$

$\therefore \quad AC^2 = 2\, BC^2$, or $AC = \sqrt{2\, BC^2}$ or $\sqrt{2\, AB^2}$.

(*b*) Now $\text{Sin. } 45^\circ = \dfrac{BC}{AC} = \dfrac{BC}{\sqrt{2\, BC^2}} = \dfrac{1}{\sqrt{2}} = \text{Cos. } 45^\circ.$

(*c*) $\text{Tan } 45^\circ = \dfrac{BC}{AC} = 1 = \ldots \ldots \text{ Cot. } 45^\circ.$

(*d*) $\text{Sec. } 45^\circ = \dfrac{AC}{BC} = \dfrac{\sqrt{2\, AB^2}}{AB} = \sqrt{2} = \text{Cosec. } 45^\circ.$

NAPIER'S RULES FOR CIRCULAR PARTS.

(Mate's and Master's.)

The Candidate to give Napier's Rules for circular parts for the solution of right-angled spherical triangles, explaining how the different angles and sides are considered in deducing the formulæ.

Napier's Rules for circular parts are:—

I.—Sine of middle part = product of tangent of adjacent parts.

II.—Sine of middle part = product of cosines of opposite parts.

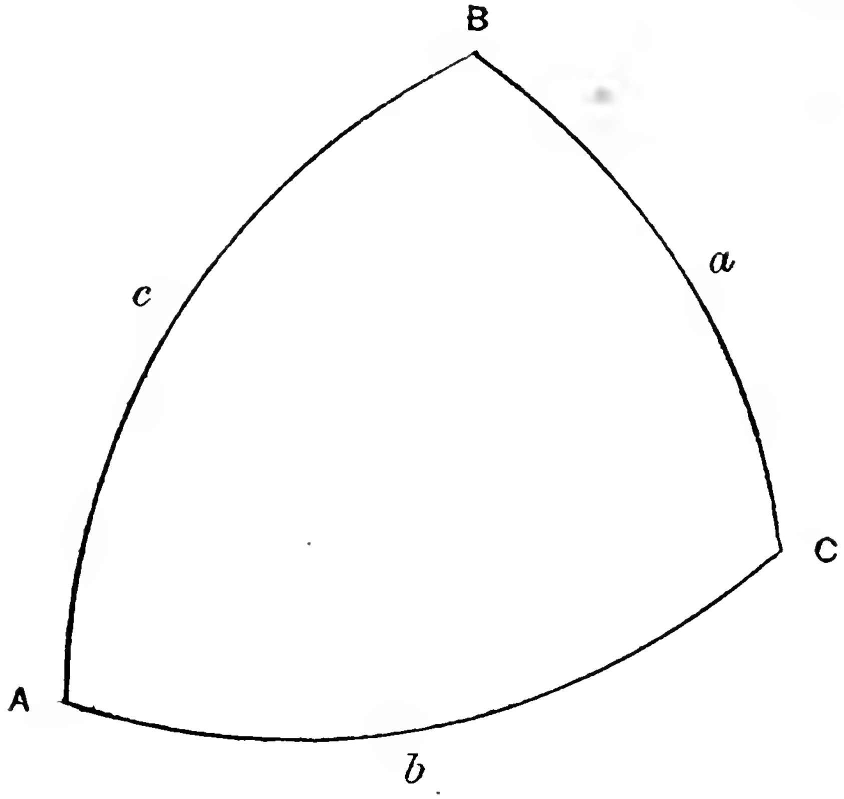
In any right-angled spherical triangle the right angle is ignored, leaving five parts, which are called the five circular parts. These parts are the two sides containing the right angle and the complements of the hypothenuse and the other two angles.

By the above rules, any two parts being given, a third can always be found.

Of these three parts one will be middle, and the other two either adjacent or opposite parts, according to their position with respect to the middle part.

Having written down the equation for the three parts (two being given, one to find), the formula is deduced for the part wanted.

Middle Part.		Adjacent.		Opposite.
1. Cosine A	=	cot. c tan. b	=	sin. B cos. a
2. Cosine B	=	tan. a cot. c	=	sin. A cos. b
3. Cosine c	=	cot. B cot. A	=	cos. a cos. b
4. Sine a	=	cot. B tan. b	=	sin. A sin. c
5. Sine b	=	cot. A tan. a	=	sin. B sin. c



Triangle A B C, right angled triangle at C.

SHIP CONSTRUCTION AND NAVAL ARCHITECTURE (MATE'S AND MASTER'S)

The following papers have been given for examination and the answers will be found on the pages given at the end of each question from Thearle's "Modern Practice of Shipbuilding in Iron and Steel" which is the text book for the Board of Trade examinations for Masters and Extra Masters.

Paper 1.

1. Explain the functions of the Sheerstrake and how it is fitted to the frames. Pp. 154 and 170.

2. Sketch and explain how a web frame is connected (*a*) to the margin plate of a vessel with double bottom, (*b*) vessels with floor plates and no double bottom. P. 98.

3. How is the longitudinal strength compensated for at the break of a raised quarter deck? P. 220.

4. What is the Breasthook? How is it fitted and why? P. 122.

5. Sketch the top-gallant rail and main rail of a sailing ship. Plate XXIX.

6. How is the plating of a water-tight bulkhead arranged, also how is it fastened to the shell, and how is it made water-tight in the way of the side stringers and keelsons? Pp. 134 and 137.

7. What is (*a*) shelter deck ship (*b*) a shade deck ship? Pp. 222-224.

8. Sketch and explain any type of rudder and pintles, also how the pintles are fitted. P. 252. Plate L.

Paper 2.

1. Name the various parts of a vessel which give transverse strength to the hull. (P. 94 and reasoning.)

2. Is there any difference in the depth of floors at transverse bulkhead frames? If so, give the reason. P. 39.

3. Give a sketch and description of an intercostal keelson associated with a bar keel vessel. P. 63. Plate, old edition.

4. Give sketches of a bilge keelson. Plate XI. (old edition more explicit).

5. What consideration regulates the depth of the margin plate in a cellular bottom, and what is Lloyd's number regulating its scantling? Pp. 88 and 17.

6. Give by means of a sketch what you would consider a good arrangement for a butt of a " seven frame shift." Fig. 4, Plate XLII.

7. Give a sketch and explain the construction of a centre plate rudder. P. 252. Plate L.

8. Name some of the considerations for the substitution of iron and steel instead of wood for masts and yards. P. 238.

Paper 3.

1. Describe in detail the framing of a cellular double bottom associated with side bar keel with solid floors at alternate frames. P. 87 (see Plate XXXIV).

2. Describe and sketch a web frame and where they are usually situated. Pp. 95 and 96. Plates XXIII., XXIV.

3. What are the functions of gunwale angle bars, and describe how they are fitted on (*a*) upper, (*b*) lower deck? Pp. 113 and 114.

4. What are sluice valves and where are they fitted? Describe their use. P. 235.

5. How is a middle keelson fitted to the reverse frames, (*a*) when the reverse frames are butted away from the middle line, (*b*) at the middle line? Pp. 63 and 65.

6. How is a Scrieve board constructed, and what is it for? Pp. 19 and 43.

7. What parts of a vessel give her longitudinal strength? Pp. 64, 65, 75, 80, 91, 113, 125, 126, 131, 258, and reasoning.

Paper 4.

1. Describe a bulkhead and give also a sketch. P. 135. Plate XXXVII.

2. Sketch a cellular double bottom, stating how the various parts are connected. P. 85. Plate III.

3. Describe how you would turn a rudder, (*a*) by manual labour, (*b*) by steam, (*c*) by hydraulic power. P. 251.

4. If after a voyage a vessel's butts in the bottom plating shows signs of dampness, what remedy would you take and why? P. 164.

5. What ratio does the freeing port area bear to the bulwarks, and how does it vary? P. 209.

6. What is meant by the "round up" or camber of a beam? State Lloyd's rule. P. 55.

7. What is the difference between poop and bridge stringer plates and lower deck stringer plates? How are they fitted? Pp. 114, 115.

8. In the case of partial steel decks, what precautions would you take to avoid a sudden diminishing of the longitudinal strength? P. 131.

Paper 5.

1. Describe the structural value of a transverse bulkhead and the various strains to which it is subjected to in a seaway, and what stiffness afforded by them is best distributed. Pp. 140, 141.

2. Sketch and describe the hatch coaming of a vessel, stating how the loss of strength due to the discontinuity of the beams is compensated, also showing how the different parts are connected together. Pp. 211, 213. Plate XLIV.

3. When wood decks are laid over steel decks, do Lloyd's regulations allow for a reduction in the thickness of the wood or steel deck? If so, state the allowance made both for the wood and steel. Pp. 128, 129, and 229.

4. State the regulations for a stringer plate, both for breadth and thickness. P. 117.

5. What relation does the size of the rivet bear to the thickness of the plate it connects, and how does the pitch vary, (*a*) in a single butt, (*b*) in a double butt, (*c*) in a treble butt. Pp. 192 and 195.

6. In a cellular double bottom ship, is there an increase in the thickness of the inner bottom plate? If so, state rules and parts of the vessel. P. 89.

7. Explain the "sheering of the deck line." Pp. 111 and 112.

8. What is an "oxter plate"? P. 174.

Paper 6.

1. What modification was made by the Board of Trade in the tonnage laws upon the introduction of cellular double bottom? P. 84.

2. What is the objection to lap jointing floors at the middle line of ship? P. 39.

3. To what height are water-tight bulkheads carried, (1) in three deck vessels, (2) in spar decked vessels, (3) in awning decked vessels? P. 134.

4. In the raised quarter deck type of a vessel, how many frame spaces apart are the web frames placed and where are they situated? P. 99 (old edition more lucid).

5. What prevents the rudder from being accidentally unshipped at sea, and what does the heel of the rudder rest upon? What prevents the rudder from being turned beyond the angle of efficiency, and what is the angle? Pp. 249 and 250.

6. Give a sketch of intercostal keelson that is usually associated with flat plate keels. Fig. 4, Plate X.

7. Write what you know of massed pillaring. Give sketches showing distribution of pillars in lower deck. Pp. 148-150. Plate XL.

Paper 7.

1. What are the functions of side keelsons? State where and how they are situated. Pp. 64-65.

2. How is the top of a water ballast tank supported, and state what precautions are taken to preserve continuity of strength at the transverse bulkhead? P. 75.

3. State how the diamond plate placed at the intersection of web frames and side stringers are placed, (*a*) when frames are cut and stringers continuous, (*b*) when frames are continuous and stringers cut. P. 98.

4. What is the difference in class between vessels of the spar decked type, and vessels of the three decked type? P. 225.

5. What are diagonal tie plates? What is their function and how are they placed and fitted? P. 126.

6. What is the best material for the making of rivets, and what tensile strain is it equal to? Pp. 190 and 13.

7. Give a description of the process by which plates are joggled. What are their advantages and disadvantages? Give a sketch. Pp. 188-189.

8. How are transverse bulkheads compensated for by the absence of a lower deck? P. 135.

9. What precautions are taken to prevent corrosion and fouling of ship's bottoms? State what you consider a good plan to prevent both. P. 255.

Paper 8.

1. Draw the midship section of a steamer and name the principal parts, and give the type of the vessel. Plate III.

2. Describe in detail the framing of a vessel in the way of a McIntyre tank. Pp. 74-76.

3. Name the various parts which form the stern frame of a screw steamer and describe how they are connected together. Pp. 34-35.

4. Describe in detail the marking and punching of a frame angle, and state from which side it is punched, and the reason for punching from that side. Pp. 40-41.

5. How are the positions of the various chain plates determined? How many shrouds, capstays, topmast backstays, topgallant backstays, should a vessel of 1,000 tons have? Pp. 247-248.

6. What are the methods for reconciling unfair rivet holes? Are any of them objectionable? If so, why? P. 184.

7. Sketch the various forms of side keelsons and describe them. Pp. 64-66. Plate XI.

Paper 9.

1. Give the various strains that the hull is subjected to, and explain how the structural value of the ship is considered to counteract such strains. Pp. 94, 141, 127, 154, and reason.

2. Give a sectional sketch of a box keelson. Explain the construction, also its disadvantages. P. 63. Plate IX., old edition.

3. Explain the advantage of iron and steel decks, and how they assist the structural value of the vessel. Pp. 126-127.

4. Give a sketch, also description of a bulwark and its use. Pp. 204-205. Plates II., XXIII., XXIX.

5. What is the best material for making rivets and its tensile strength? Pp. 13 and 190.

6. Describe the construction of an iron or steel topmast, and where and why the plates are doubled P. 242.

7. Explain the laying of keel blocks, what governs the heights and declivity, also, what is the usual declivity. Pp. 27-28.

Paper 10.

1. Describe and give sketches of a good method of ventilating ships' holds, also when the gases which accumulate are heavier than air. (Not explained in Text Book. Forced Ventilation is required either from fans or steam injections.)

2. When are widely spaced and extra strong beams fitted? Give a sketch and explain how the beams are connected to the stringer plate for additional strength, also how the stringer plate is supported between the beams. Pp. 115-116.

3. Describe the method of punching the reverse frames, and what holes are punched before and after bending. Also, what governs the spacing of the spar ceiling connecting bolts. P. 42.

4. Describe and give a sketch, how the floors are arranged and fitted in the vessel with a continuous centre plate keelson. P. 62. Plate X.

5. Describe what you know of "Fairing the body." P. 18.

6. Describe how wood decks are fitted and secured when laid over beams, also when laid on top of iron or steel decks, also give sketches. Pp. 227, 231.

7. Give a sketch and describe what are meant by stealers. P. 161.

Paper 11.

1. How are the various parts marked by the Manufacturers, so that they will be known where to fit each part in the Shipyard? Pp. 24-25.

2. Give a short description of how frames, reverse frames, floors, etc., are fitted and riveted before being hoisted up on their places on the keel. Pp. 52-53.

3. How are web frames and stringers united at their intersection? Give a sketch. P. 98. Plates XXIV. and XXV.

4. Sketch and describe a steamer's hatchway, and how loss of strength is compensated. Show how beams are connected to coamings. Pp. 209-213. Plate XLIV.

5. How are the caps fitted to lower and topmasts and how constructed? Pp. 243-244.

6. What are Lloyd's rules for the spacing of beams, for main, upper, and spar decks? Where steel decks are fitted is there any difference made? Pp. 53 and 130 (old edition more explicit).

7. What are Lloyd's regulations for number of water-tight bulkheads in a steamer, and how is the position for the collision bulkhead found? P. 133.

8. Describe and sketch the template used for templating the ordinary plating of a ship. P. 177.

Paper 12.

1. Explain the functions of a garboard strake and how it is connected (*a*) to flat plate keel, (*b*) bar keel, (*c*) and side bar keel. Pp. 29, 31, and 176.

2. Describe the functions of an upper deck stringer plate, and how it is connected to the shell plating. Pp. 113-114.

3. Give a sectional sketch of a vertical plate keelson, and when the second number is 33,000 what extra strength is added in regard to the buttstraps. P. 62. Plate X., Fig. 1. (See footnote.)

---

3. When the plating number is 33,000 and above, a foundation plate 18 inches broad and $\frac{18}{20}$ of an inch thick is fitted on top of the floors under the middle line plate keelson, and the butt straps have to be treble riveted. (From old edition.)

4. Does punching the plates weaken the tenacity, and what special precautions are made in regard to thick plates. Pp. 198 and 11.

5. What plates are rimed or annealed after punching? Name some parts of the vessel which require such treatment. (See footnote.)

6. Explain how the diameters of a lower mast and topmast vary when made in one, and how are the stiffeners carried up through. P. 240.

Paper 13.

1. To what stresses is a ship's hull subjected to, and what provisions are made to guard against those stresses. Pp. 94, 141, 127, 154, and matter of reasoning.

2. Sketch the stern frame of a single screw steamer, and explain how the body post is connected to the hull. Also how the stern post is connected to the hull. Pp. 34-35. Plate XII.

3. If the vessel is too broad for continuous floors, state and give a sketch of how they are connected and where. Give the different methods. P. 38.

4. Where are the reverse frames doubled, and how many diameters the rivets should be spaced in the frames, reverse frames, and floors. P. 40.

5. What is a "Specification"? What does it contain and what guidance does the Shipbuilder get from it? P. 15.

6. How are the frames lifted into position, and what is meant by horning the frames? Pp. 59-60.

Paper 14.

1. Give a sectional sketch of the machinery space of a steam vessel, showing the principal parts. Plate IV., old edition.

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5. Stringer plates, sheerstrakes, garboard strakes, and all butt straps when above $\frac{10}{20}$ of an inch in thickness, are to be carefully annealed, or the holes sufficiently rimed after punching, to remove the injurious effects of punching. (From old edition.)

2. Are the bulkheads to deep water ballast tanks additionally stiffened? If so, how, and what is the reason? Pp. 138 and 139.

3. How is the stem and stern post connected to a bar keel in a sailing vessel, and what is the arrangement of the rivets connecting them? Pp. 29 and 34.

4. Give a sketch of the rudder of an iron or steel vessel stating all the details of its construction. Plate L.

5. What considerations govern the position and capacity of water ballast tanks? P. 74.

6. What regulates the thickness and number of iron and steel decks in a vessel? P. 128.

7. What is the usual material used for the standing rigging of a modern sailing vessel, and what qualities should it possess? P. 248.

Paper 15.

1. Explain how a bar keel is fitted, also how it is connected to shell. Give a sketch and state the sectional area of the bar keel. Pp. 29 and 176. Plates II., XIV., and XVII. (See footnote.)

2. State briefly what materials are ordered from the model, and what excess is usually made by the Shipbuilder. P. 17.

3. State the functions of a transverse bulkhead and state how the strength is distributed over the structure of the vessel. Pp. 132, 140, and 141.

4. State what you know of the two types of cellular double bottom, and what are their principles with regard to each other. Pp. 84 and 87 (entirely different meaning in old edition).

---

1. A vessel of 100 tons has a bar keel $6'' \times 1\frac{1}{8}''$.
do. 6000 do. do. $12'' \times 3\frac{3}{4}''$. (From old edition.)

5. Describe how lower and main deck stringer plates are connected to the shell. P. 114 (Par. 81).

6. State the breadth of single and double riveted butt straps. Pp. 170 and 166, table on page 167.

7. What is the method of cementing ships' bottoms and where is it thickened? State what you would consider a good thickness. Pp. 234 and 235.

Paper 16.

1. How are Lloyd's numbers for scantling arrived at, and what scantlings are regulated by same? Pp. 16 and 17.

2. What regulates the diminuation in depth of floor plates from centre of ship? P. 37.

3. Explain the various forms of beam knees, and give sketches. Pp. 56 and 57.

4. Name the different types of deck plating, and how are the plates connected at their edges. Pp. 129 and 130.

5. What gives the greatest structural strength to a vessel, and how is it stiffened? P. 94.

6. Does the inside or outside of a vessel corrode more rapidly, and what steps are taken to prevent same? P. 233.

7. What quality should the material of an iron or steel vessel have, and what are the tests for same? Pp. 10-14.

8. Give a description of a deck stringer plate and what are its functions? Give sketch. P. 113. Plate XXIX.

Paper 17.

1. What is meant by bevelling the frames? Why is it necessary and how is it done? Pp. 20 and 44.

2. Explain how a water-tight flat is made water-tight at shell connections. P. 142.

3. Sketch a midship section of a sailing vessel and name the various parts. Plate II.

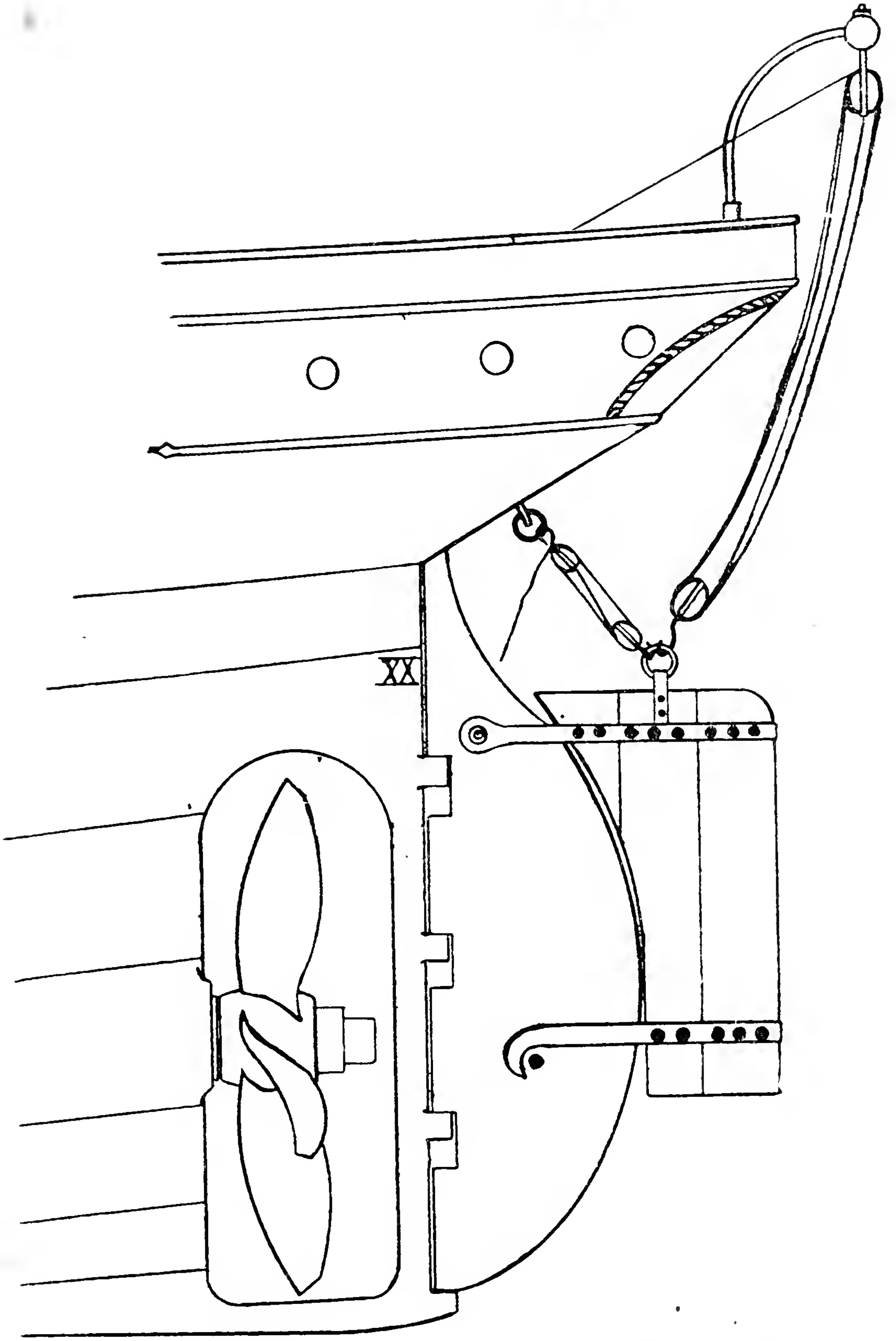
4. Sketch and explain the several types of stringers. Pp. 108-115. Plates II., III., and XXIX.

5. What is a flat plate keel, and explain how it is let into structure of vessel. Give a sketch. Pp. 31 and 32. Plates III., IV., and V.

6. What is the thickness of inner bottom plating in cellular double bottom vessels? P. 89.

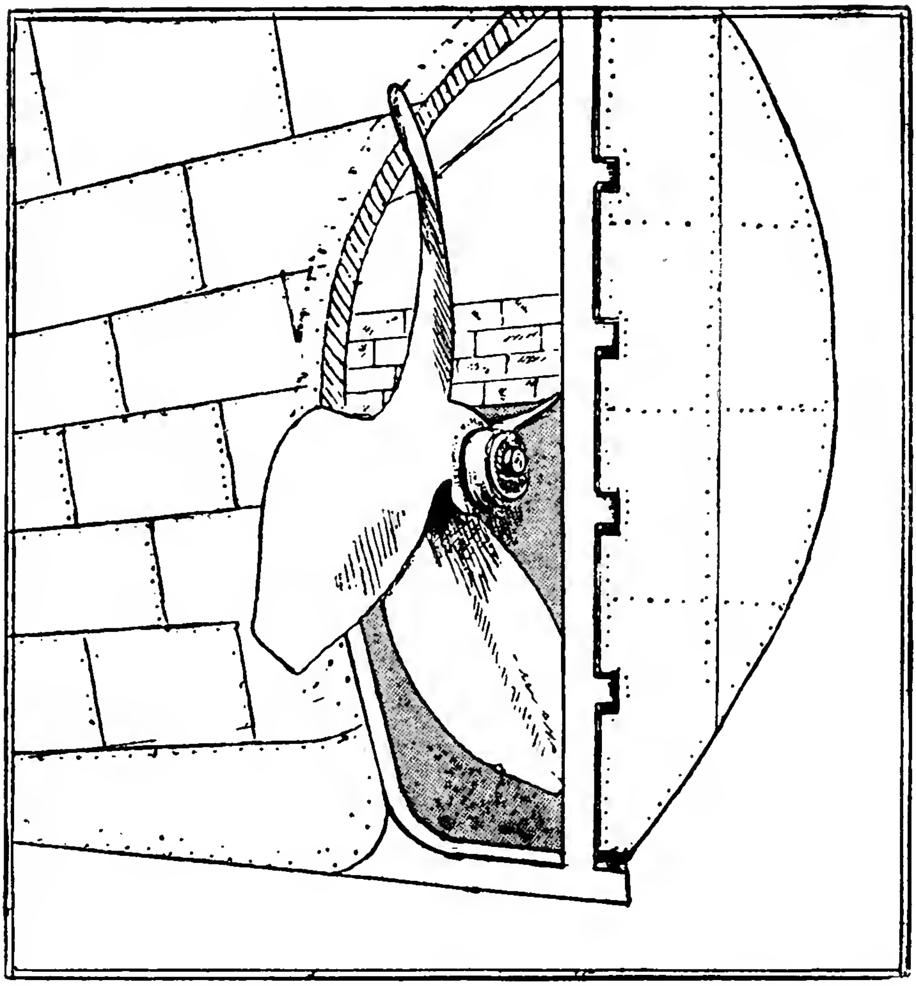
7. How is the strength of web frames distributed about structure? P. 99 (old edition more explicit)

Fig. 120.



AUXILIARY RUDDER FOR RIVER DANUBE.
(DANUBE RUDDER.)

Fig. 121.



RUDDER AND PROPELLER.

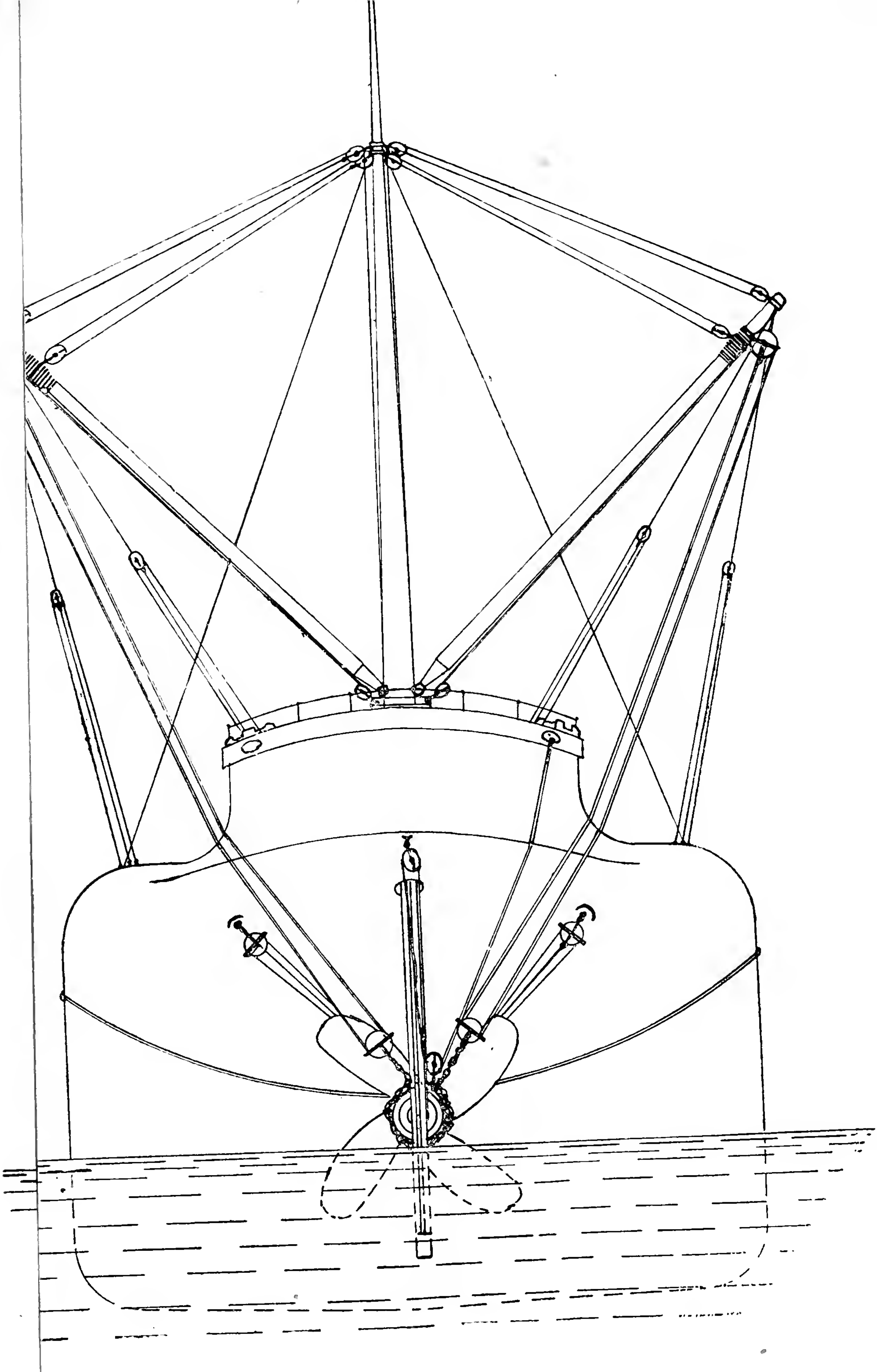
LOAD LINE MARKS FOR VESSELS.

Winter North Atlantic.

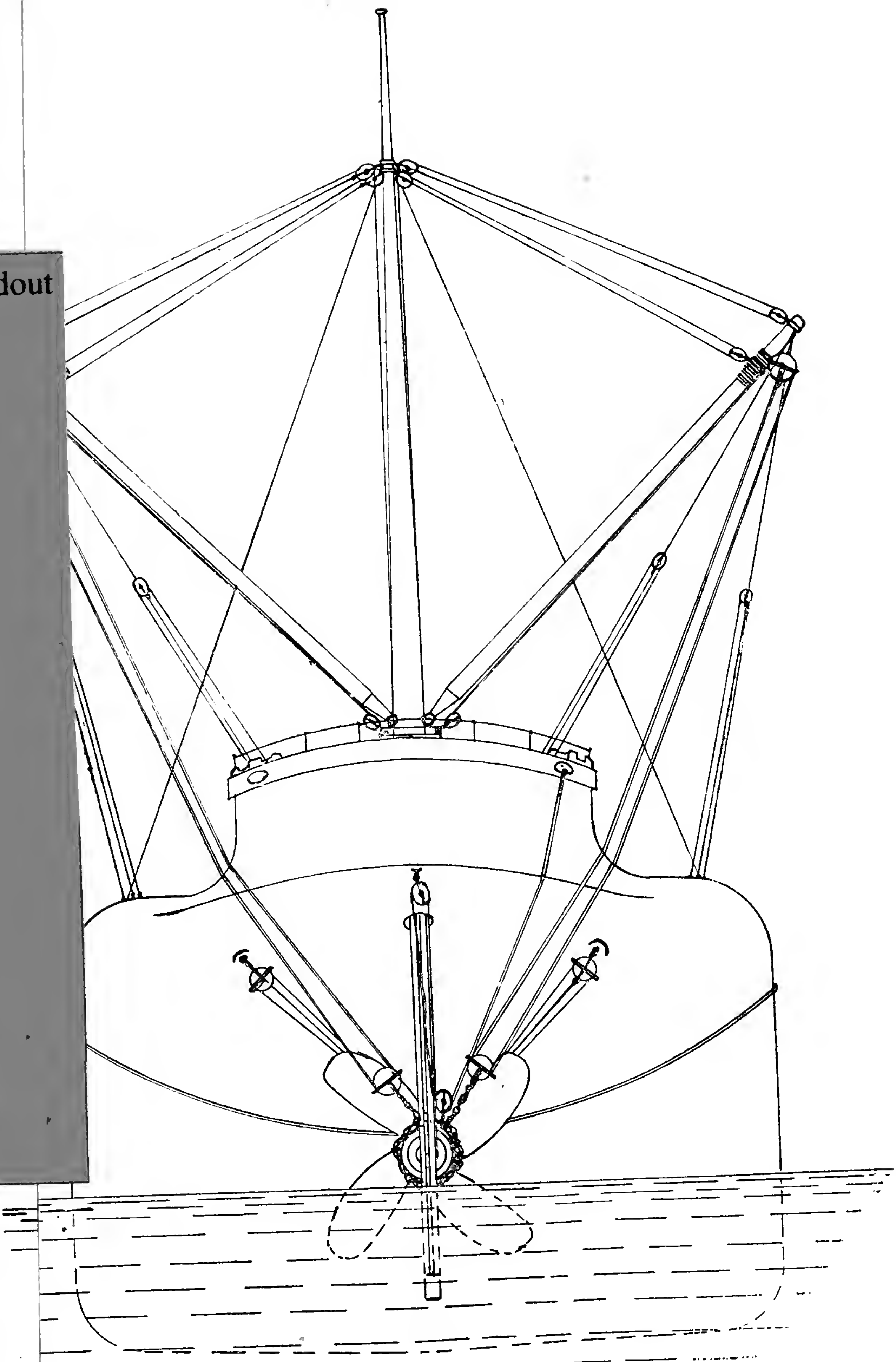
The winter North Atlantic mark applies to vessels trading to the North of a line from Gibraltar to Cape Hatteras, between the months of October and March inclusive.

Indian Summer.

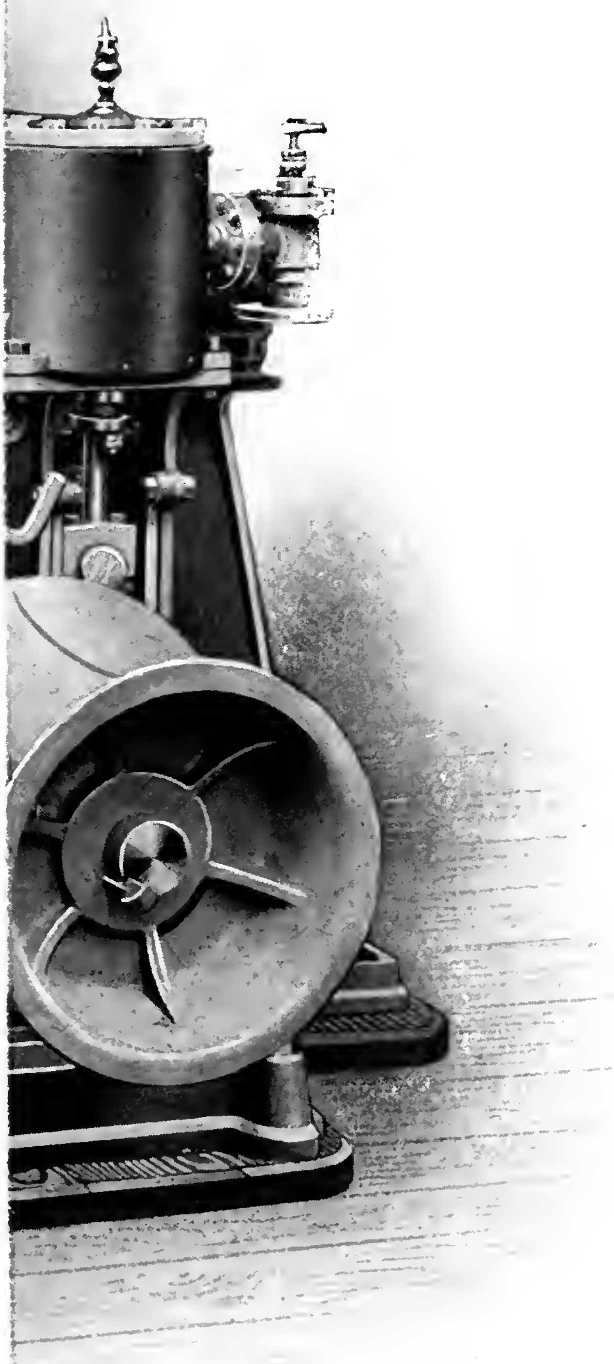
The Indian Summer mark applies to vessels trading between Suez and Singapore. Seasons, 15th November to 25th May to the eastward of Tuticorin, and 1st Sept. to 25th May to the westward of Tuticorin.



HE PACIFIC OCEAN.



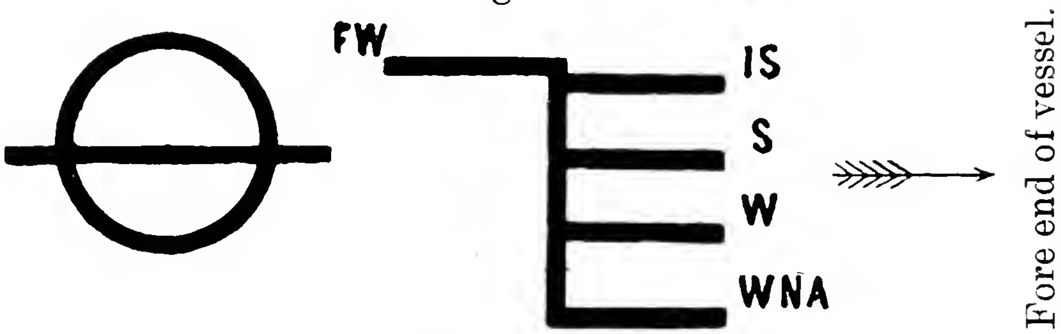
HE PACIFIC OCEAN.



R.

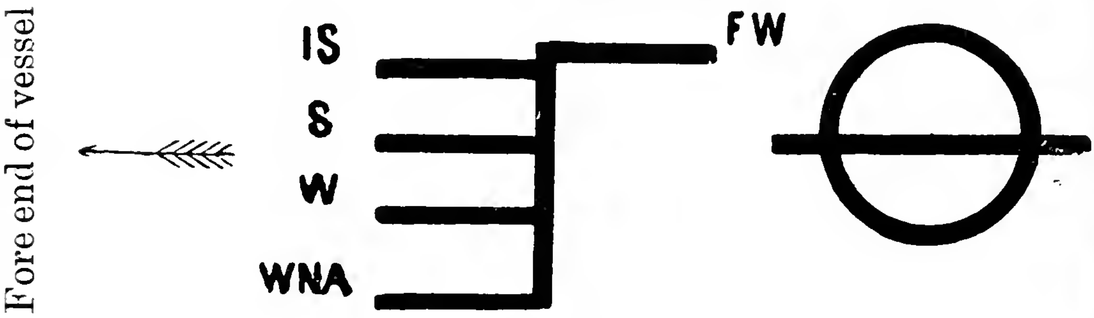
LOAD LINE MARKS FOR STEAMSHIPS.

Fig. 124.



Starboard Side.

Fig. 125.

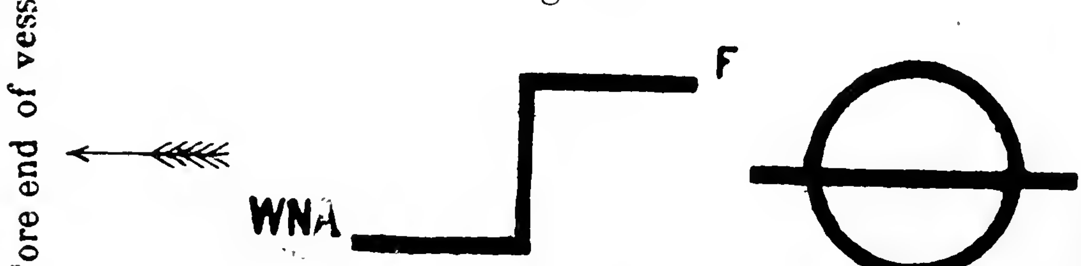


Port Side.

FW—Fresh Water. IS—Indian Summer. WNA—Winter North Atlantic
S—Summer. W—Winter.

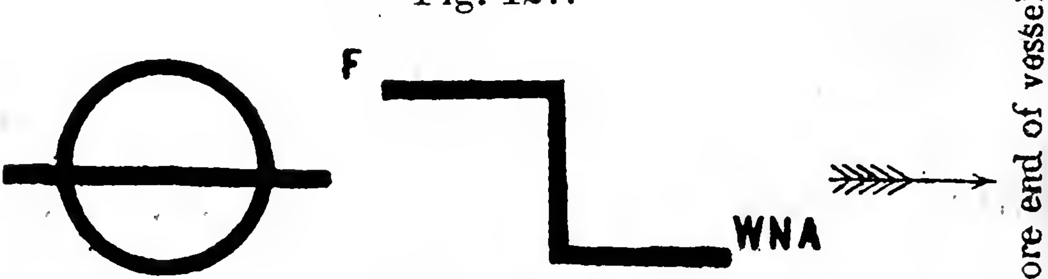
LOAD LINE MARKS FOR SAILING VESSELS.

Fig. 126.



Port Side.

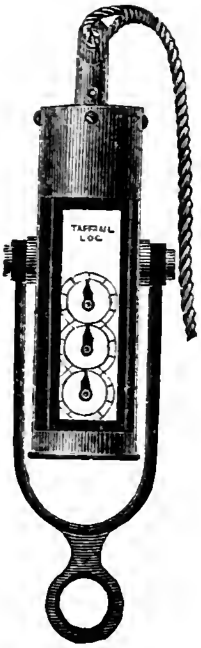
Fig. 127.



Starboard Side.

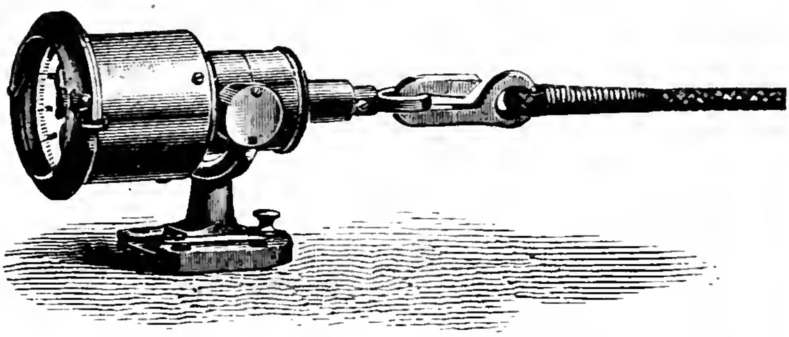
F—Fresh Water Mark. WNA—Winter North Atlantic.

Fig. 128.



BLISS PATENT LOG.

Fig. 129.

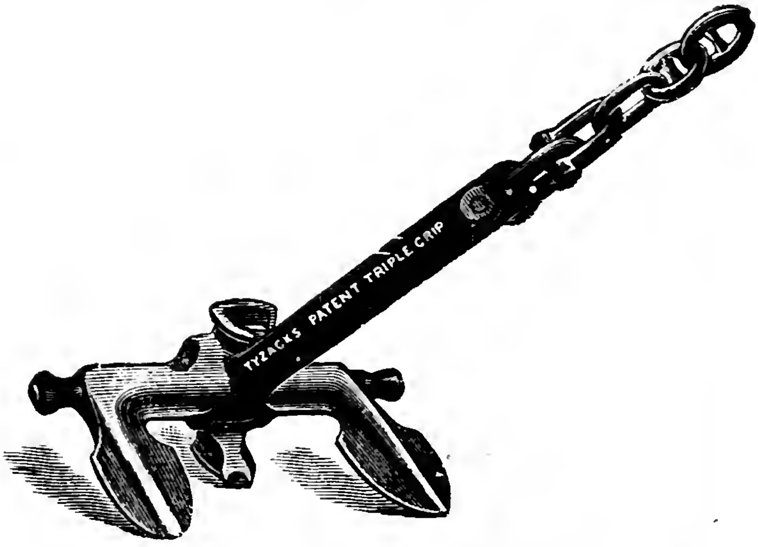


WALKER'S PATENT LOG.

Fig. 130.

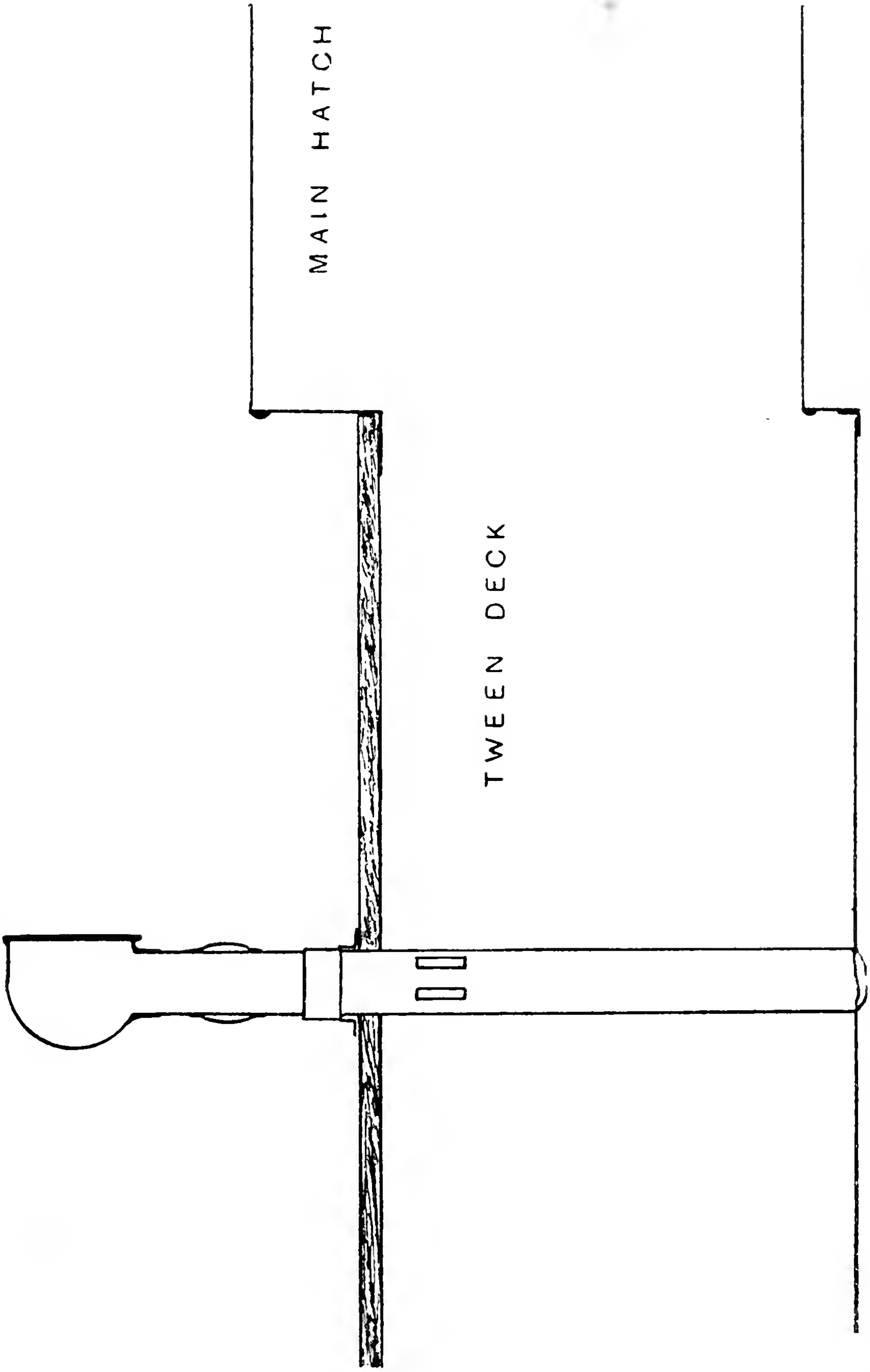
ANCHORS STOWED IN HAWSE PIPES.

Fig. 131.



PATENT ANCHOR. (See p. 15.)

Fig. 132.

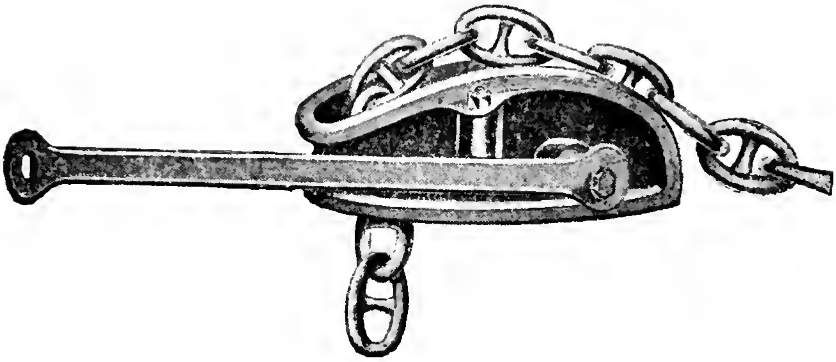


VENTILATOR SHOWING AIR HOLES IN 'TWEEN DECKS.

Fig. 133.

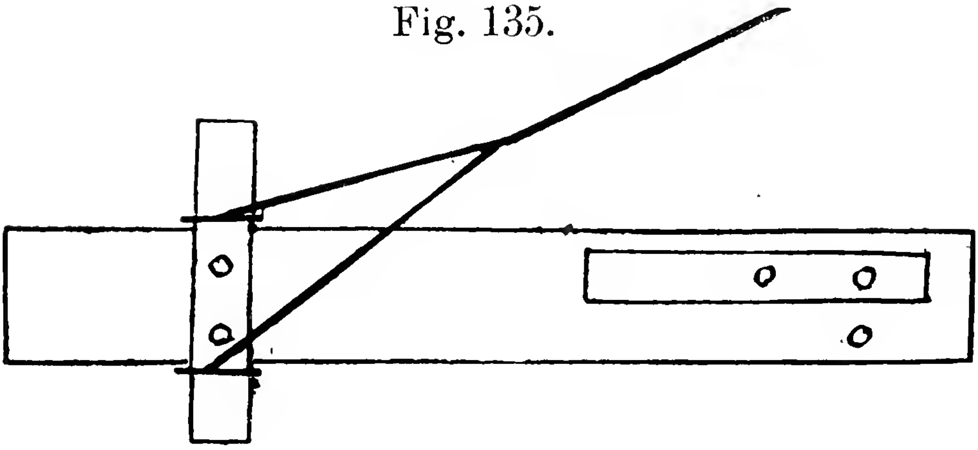
BOW STOPPER.

Fig. 134.



CHAIN PIPE STOPPER.

Fig. 135.



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